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PROCEEDINGS OF THE PUERTO RICO PUBLIC MEETING, ON THE NATIONAL ESTUARINE POLLUTION STUDY HELD AT THE PUERTO RICO BAR ASSOCIATION BUILDING, SANTURCE PUERTO RICO ON APRIL 22, 1968

Federal Water Pollution Control Administration
Atlanta, Georgia

April 1968

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PROCEEDINGS

of the

PUERTO RICO PUBLIC MEETING

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NATIONAL ESTUARINE POLLUTION STUDY

FEDERAL WATER POLLUTION CONTROL ADMINISTRATION

April 22, 1968

Puerto Rico Bar Association Building

Santurce, Puerto Rico

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ATTACHMENTS

PUBLIC MEETING
NATIONAL ESTUARINE POLLUTION STUDY
FEDERAL WATER POLLUTION CONTROL ADMINISTRATION

Puerto Rico Bar Association Building Santurce, Puerto Rico
April 22, 1968

- - -

The public meeting directed toward obtaining contributions from Puerto Rican interests regarding the National Estuarine Pollution Study being conducted by the Federal Water Pollution Control Administration convened in the theatre of the Puerto Rico Bar Association Building, Monday morning, April 22, 1968, and was called to order at 9:35 o'clock p.m. by Regional Director, John R. Thoman, Southeast Region, Federal Water Pollution Control Administration.

MR. JOHN R. THOMAN: Would you please be seated. We still don't have the microphones for the table, but we figure that rather than delay any further, we would just get started.

One of the customs in the southern part of the United States that I rather like is to start public meetings off with a very short prayer. So if you would all rise for just a moment. This is a very ancient prayer from the Byzantine Rite Mass of the Roman Catholic Church.

Oh Lord, Who dost bless them who bless Thee and dost sanctify them who trust in Thee, save Thy people and bless Thine inheritance. Give peace to Thy world, to Thy churches, to our government, to our armed forces and to all Thy people.

For every good and perfect gift is from above and comes down from Thee, oh Father of Lights. And to Thee do we render glory, thanksgiving, and worship now and always and forever and ever. Amen.

I am John R. Thoman, the Southeast Regional Director of the Federal Water Pollution Control Administration in Atlanta, Georgia.

I want to welcome all of you to our fifth public meeting together to gather information for the National Estuarine Pollution Study.

Other meetings have been held in Mississippi, Georgia, Florida, and just last week in the Virgin Islands.

Most of you already know the specific purposes and reasons for this meeting. For some of you who may not, let me outline them briefly.

The National Estuarine Pollution Study was authorized under the Clean Water Restoration Act of 1966. In that Act, the Congress directed the Department of the Interior to make a comprehensive study of pollution problems in the coastal and estuarine areas and to report to the Congress recommendations for future management programs.

This study is to be completed and a report made to Congress by November of 1969. We in the Southeast Region are the first to conduct public meetings for the study, to obtain the views and opinions of public and private groups and individuals who have an interest in the use of Puerto Rico's estuarine and coastal waters.

Many of you were invited to make statements here today. However, this does not mean that anyone, invited or not, may not express his views. Anyone who wishes to make a statement, who has not already so indicated, should let Mrs. Brown or one of the girls at the registration desk know, and we will get you on the program.

We are cooperating with the Commonwealth of Puerto Rico in holding this meeting. Governor Sanchez has directed Ramon Garcia, Chairman of Planning Board of Puerto Rico, to represent the Commonwealth's interests.

Mr. Santiago will be a member of our panel today to hear your statements and perhaps ask some questions for clarification.

The other member of the panel, besides myself, is Mr. Paul Traina, who is the Director of Technical Programs in our Southeast Water Laboratory in Athens, Georgia.

I would like to express that this meeting is yours, not ours. We are here to listen and to learn. What you say is important, in that it will become a part of the report to Congress.

It will contribute to the development of the national policy for estuarine management. It will help us to determine the various beneficial uses of our invaluable estuarine and coastal waters and their interrelationship and to plan for their uses so that the maximum public good may be achieved.

The meeting record will be held open for 15 days following today to receive any statements that any of you may wish to make or any clarifications or additional statements you may wish to submit.

Mr. Tom Crites will be making a verbatim record of the transcript, and these will be available in about a month to six weeks.

One thing I would like for you to do is to please identify yourself very slowly so that Mr. Crites will be able to get your name correctly.

As our first witness today, I would like to call on my very good friend, Mr. Orlando Gonzales, the Executive Director of the Puerto Rico Aquaduct and Sewer Authority, who will be speaking for various agencies of the Commonwealth government. Mr. Gonzales.

MR. ORLANDO GONZALES: Mr. Thoman, members of the panel, ladies and gentlemen: My name is Orlando Gonzales. I am Executive Director of the Puerto Rico Aquaduct and Sewer Authority.

I am representing the Commonwealth of Puerto Rico. I would like to extend a warm welcome to you on behalf of the Commonwealth of Puerto Rico. We are fully aware of the importance of your mission here, and assure you of our earnest desire to cooperate, as we have in the past, to help make your mission a success.

Your study of the factors that contribute to pollution of our estuaries and coastal waters will, no doubt, be of great benefit to us.

For our part, we want to offer what we can in terms of information, ideas, and viewpoints to contribute to the solution of this problem, not only in Puerto Rico, but throughout the United States.

I believe that, in saying this, I am expressing not only the wishes of the Commonwealth government, but also of the great majority of our manufacturers, civic groups, and individuals, many of whom have taken time from their busy schedules to appear before you today.

To this end, we are preparing complete and detailed information for you on the entire question of estuarine and coastal area pollution in Puerto Rico. The information is now being gathered by the Planning Board and will shortly be made available to you.

Let me add that an important part of this information is based on the excellent work accomplished by your own staff in the report on "Water Pollution Control Needs for Puerto Rico's Coastal Waters", which you completed in June of last year.

Your being here today will help us once again call public attention to the fact that progress, in Puerto Rico or elsewhere, has its price. Public awareness of this fact, and public willingness to pay the price required to rid Puerto Rico of the harmful effects of pollution, is a basic starting point for effective action.

As you will be able to judge during the remainder of this hearing, we are encouraged by a growing public awareness on the dangers of pollution.

In some ways, our fight against pollution has only just begun. The accelerated population growth and the need to match such growth with accelerated industrialization have severe implications for policies concerning water pollution here.

Industrial wastes will continue to increase as more new factories are added under the Bootstrap Program.

Urban sewage, garbage, and other wastes will have to be treated on a massive scale, if we are to avoid wholesale contamination of our waters. There is no doubt that this problem requires, and that is has, the full concern, interest, and determination of the Commonwealth government.

It would be well to ponder for a moment the costs involved in massive antipollution action. In your own report of last June, you estimated that solving coastal water pollution problems in Puerto Rico during the next decade would require a capital outlay by industry and government of at least 130 million dollars.

These figures may seem out of proportion, compared to the problem we face in Puerto Rico, yet our studies clearly show that at our present rate of population expansion, we shall have, by 1975 -- only seven years from today -- a population density of almost 1,000 persons per square mile.

This is comparable to packing the entire population of the earth into the continental limits of the United States. To maintain the rate of industrial growth required by this population expansion, Puerto Rico will have to have, by 1975, more industrial plants per square mile than the United States.

Population in our urban areas along the coast is now growing five times faster than our total population. By 1975, Puerto Rico's urban areas will hold 65 per cent of our people, compared with only 30 per cent in 1940.

On the other hand, in the face of such vigorous growth, we still have a per-capita income that is one third of that of the United States average, and half that of Mississippi, the poorest of the states.

Between 11 and 12 per cent of our work force remains unemployed, and there is, despite our impressive progress, still legitimate and serious poverty in Puerto Rico.

To give you a meaningful example of the kind of problems this presents, I can point out that the operational agencies of the Commonwealth government, after receiving instructions to request funds for only necessary and essential public works, submitted a combined budget request to the Planning Board, a request for 224 million dollars for the coming fiscal year.

The Board, analyzing these requests in the light of estimates of funds to be available next year, was only able to recommend a total of less than 85 million dollars, about a third of what the agencies indicated was urgently needed.

I bring these statistics to form a backdrop to our consideration of estuarine pollution and to indicate the kind of obstacles we must overcome.

The progress we have been able to achieve to date in the fight against pollution has been considerable. But the problems we face in the future are more formidable than any we have yet known.

The technical, administrative and financial aid provided by agencies of the Federal government has been a key factor in our efforts to date. We are confident that this will continue to be true in the future.

In specific terms concerning estuarine pollution, it is a reality that the Federal, state, and commonwealth governments are just beginning to develop the very specialized knowledge required to understand the estuarine environment and the harm done to it by pollution.

In Puerto Rico, we are not quite certain whether the values derived from the use of our estuaries economically justifies the investments required to properly deal with the problems.

As I mentioned before, we are missing the information required to reach this determination. However, the extent to which estuarine pollution diminishes the following falues and uses is the extent to which we shall consider antipollution measures necessary, desirable, and economically justified.

1. Aesthetics. This is a consideration often related to tourism, but our position of the need to prevent the destruction of the aesthetic qualities of our estuaries goes beyond the immediate economic consideration of tourism.

The garbage dumps and open sewer outfalls along the periphery of San Juan Bay are receiving immediate and effective attention, as I shall later describe.

The turbid waters at the mouths of many streams, industrial outfalls spewing wastes onto island beaches, and the unpleasant odors along the waterfronts of many municipalities are prime targets for action in the Commonwealth's antipollution program.

2. Preservation of natural phenomena. Certain coastal areas, such as the phosphorescent bays in La Parguera and Vieques, the portion of the Mayaquez coast line that will house the proposed Marine Biology Laboratory, and other coastal sectors of valuable and unique marine life are also receiving special attention.

A master plan for the development and preservation of the phosphorescent bays is being drawn up with the expert aid of the National Park Service, and several Commonwealth agencies are actively engaged in studies to determine standards for the use and preservation of the other areas I mentioned.

3. Bathing and other water-contact sports. This use has, admittedly, not received the attention it deserves, principally because of the overwhelming problems in other more crucial pollution areas.

Yet, as our progress continues and leisure time grows among the general population, pollution effects on our beaches and harbors will become a serious detriment to sane and healthy public recreation.

We are now bringing this factor into sharper focus in our plans for the future.

4. Commercial fishing. Puerto Rico has surprisingly little commercial fishing activity, considering the fact that we are surrounded by water. Our limited bays and estuaries are not considered important fish-spawning environments, although some 11 million pounds were fished commercially in 1967, including some commercial shellfishing, principally at Rincon Bay in Boqueron.

The exact effects of waste discharges on fish and shellfish propagation are not well known. Some nutrient build-up in San Juan Bay seems to favor fish productivity, while toxic waste discharges in Guanica Bay have caused fish kills.

More information is needed in this area to determine the extent of public action to be taken. However, it is possible that anti-pollution measures undertaken with other goals in mind will also improve the situation with respect to this use.

5. Industrial water supply. Use of Puerto Rico's coastal waters for industrial purposes is presently limited to cooling thermal power and petro-chemical plants.

Some slime problems have recently appeared, particularly in Tallaboa Bay, where high pollution exists. The future possibility of being able to economically convert sea water to drinking water will require a more thorough look into the problem of slime and other damaging effects to industrial plants that can be traced to pollution.

Sanitary surveys conducted by the Commonwealth Health Department have uncovered the most serious estuarine pollution problems in the bays of San Juan, Guanica, and Tallaboa, and to a lesser extent in La Parguera Bay.

In addition, heavy estuarine pollution is found in the Condado, San Jose, and Rincon lagoons, as well as at the mouths of the Yaquez, Loiza, and Camuy rivers.

Considerable pollution also occurs along the coastal areas of Palo Seco, Arecibo, Mayaquez, and Ponce. The sources for such pollution are varied.

One principal source that is growing is municipal solid wastes that are either carried by streams and rivers to the estuaries or dumped directly into coastal waters.

Efforts are under way to develop more rational and safer garbage disposal systems for Puerto Rico's municipalities, perhaps by combining garbage collection operations of several adjoining municipalities to economically support efficient sanitary fill or incineration operations.

In this regard, the municipality of San Juan is pioneering with the construction of a disposal plant that will convert much of its daily refuse into a marketable compost product.

The sucess of this operation would be a significant step forward in this problem. Municipal slaughter houses, responsible for considerable estuarine and coastal pollution, are also studied with the purpose of combining the present small operations in each municipality into several larger modern facilities with adequate waste treatment.

The major obstacle to carrying out the plan is one of available funds in the light of other more pressing public needs.

In the case of industrial pollution, there are several new mechanisms that prevent the establishment of new factories in Puerto Rico that do not, or cannot, control their waste products.

Our new water quality standards for inland streams and coastal waters give us the yardstrick from which to judge the appropriate pollution control resources required for any new industry in Puerto Rico.

The laws and regulations in Puerto Rico regarding water quality expressly prohibit harmful waste effluents in our waters. At present, we are also developing a complete system of industrial performance standards to cover not only water pollution dangers, but other types of industrial nuisances, such as smoke, gases, noise, vibrations, glare, et cetera.

The system will allow us to determine in advance, through expert analysis of factory plans, equipment, specifications, fuel, and raw material to be used, as well as other data, exactly what nuisances are to be produced, which ones are to be controlled, and which ones are permitted in certain specified zones of the Island.

This new system, which will form part of our zoning regulations, should actually encourage cleaner industrial operations by offering better zoned sites for industries that can and are willing to control their production of community nuisances, including their wet waste products.

As for new residential building, there is a procedure for assuring that proper treatment facilities are provided, either by the Commonwealth or the private builder, before use is permitted of the new construction.

As with industry, we have learned that the cost of preventing pollution can and should be borne by those who would produce it. There are times, of course, when we face the dilemma of significant economic or social benefits to be derived from a new project, as opposed to the detrimental pollution effects it can produce.

However, as technology in the field continues to increase and economic feasibility becomes more practical, these types of programs will hopefully no longer be with us.

Thus, in a very real sense, we can anticipate effective, meaningful control over the growth of pollution problems in Puerto Rico's coastal areas and estuaries, provided, of course, that technology in the field is able to eliminate potential sources of pollution at reasonable costs.

Here, of course, is a whole area of research and development that requires vigorous public and private action. I know of the Federal government's intense interest in this endeavor.

For our part, we have moved into more active cooperation with university and professional researchers, both here and abroad.

The commonwealth's Economic Development Administration maintains an industrial laboratory and is moving ahead with land acquisition and site plans for an impressive scientific community to be established in Mayaguez.

The Commonwealth government has committed acreage to Associated Universities, Inc. for the establishment of a Marine Biology Laboratory to be funded by the National Science Foundation.

And my own agency, the Aquaduct and Sewer Authority, as well as the Department of Health, the Planning Board, Fomento, and others are developing scholarship and training programs to upgrade government personnel concerned with pollution problems.

We still have far to go, but a healthy and vigorous start is being made. The most challenging problem that remains, in our opinion, just as vital as safeguarding against increased pollution in the future, is that of the harmful effects of pollution that exist today.

In the case of industry, this requires extensive negotiations, studies, and investigations to determine how a particular industry can be made to conform to present water quality standards that were not in effect when the industry first began its operations here.

The problem is particularly acute, for example, in the case of sugar mills, who are principal polluters, but who simply cannot afford to purchase the equipment necessary to prevent such pollution.

This is an area presently receiving priority attention from the Commonwealth's Health Department.

Pollution from rum plants also requires more intensive study to devise ways to neutralize the dangers to coastal water quality from this important local industry that presently supplies a full 17 per cent of our General Fund revenues each year.

Equally needing study are ways of preventing or prohibiting pollution from the literally thousands of boats and vessels that move in and out of our bays, from Federal facilities that dump raw or semi-treated wastes along our coasts, from the growing run-off of agricultural pesticides and insecticides and other sources of estuarine and fresh-water pollution.

Existing domestic wastes are still another great problem. When the Commonwealth undertook its original water pollution control program in 1945, there was not a single secondary treatment facility in use anywhere in Puerto Rico.

Today 75 per cent of the island's 76 municipalities have at least primary facilities, and 27 secondary treatment plants have been constructed. The new Ponce facility, now being built at a cost of more than 11 million dollars, will be the largest secondary treatment plant in all of Latin America.

At this moment, we have another 13 secondary treatment plants scheduled for construction in fiscal 1969, and 30 more being programmed for the immediate future.

Our goal is the elimination of all septic, Imhoff tank, and raw sewage discharges around the island within the shortest possible time, meaning the next few years.

In addition, the San Juan Metropolitan Sewer Project, being built at a cost of 50 million dollars, is now about two-thirds completed.

The extension of the treatment plant at Puerto Nuevo and a sizable upgrading in the degree of treatment it can offer will have direct beneficial results in its improvement of water conditions in the San Juan Bay and Condado Lagoon.

We have also begun a construction program for the collection and disposal of sanitary sewage in rural communities. The first project in this program, which will have lateral sewers and a secondary treatment plant, is to be jointly innaugurated by Federal and Commonwealth officials tomorrow in the community of Florida in Barceloneta.

The next project on the list is at the community of Loiza Aldea, which will contribute to clearing the Loiza River estuary of some of its pollution sources.

We are still aware of the great need to move quicker and do more to assure Puerto Rico the benefits of economic and social progress in a safe, healthy, and sound environment.

We, in Puerto Rico, are fortunate to be blessed with one of the world's finest climates and with abundant and inspiring natural scenic beauty. Despite the very real concerns that exist for public action on many fronts, we know that, because of the God-given attributes of our island, we have more to lose than most other areas from the blight and damages of uncontrolled estuarine pollution.

It is, therefore, the understanding and firm resolution of the Commonwealth government to cooperate fully and completely in any and all efforts to guarantee the success of the National Estuarine Pollution Study, and the work of the Federal Water Pollution Control Administration.

Thank you very much. (Applause)

MR. THOMAN: Thank you very much, Mr. Gonzalez.

Mr. Ramon Santiago has arrived, and I believe he would like to make a few preliminary remarks.

MR. RAMON GARCIA SANTIAGO: My name is Ramon Garcia Santiago, and I am President of the Planning Board, and I am here participating as a representative of the Commonwealth government of Puerto Rico.

I want to say that those of you who wish to present your papers this morning may do so. I believe this is a recognition that we must make to Mr. Jack Thoman and to his staff and his office, located in Atlanta, Georgia.

The Federal Water Pollution Control Administration has made it possible so that you may express yourselves in either English or Spanish. So the public may make any comments in Spanish, if they so wish.

For those of you who do not know Jack Thoman, I want to say that Jack is one of the ablest Federal officials that I have known, and I also want to say that Jack is a very good friend of Puerto Rico.

He has shown this to all of us who have met him before. And I know he will be helpful to Puerto Rico in the area in which he is responsbile, and this is in relation to water pollution.

I consider myself a good friend of Jack, and I know that Puerto Rico has a good friend in Jack Thoman and all of his staff.

I am sorry, but because of some work I was doing for the Administrative Assembly that is meeting now, I wasn't able to be here at

9:00 o'clock. I regret very much that I could not be here, Jack, but please know that all of us in the Commonwealth government are very, very grateful to you, and we want to offer any cooperation that you might wish.

Just ask, and we will give it to you.

MR. THOMAN: Thank you very much, Ramon. I think after all of those very kind remarks, we ought to stop the record at that point. We don't need to have the meeting.

Next, I would like to call on Dr. M. Cerame-Vivas, Department of Marine Sciences at the University in Mayaguez.

DR. M. CERAME VIVAS: I beg your indulgence. Most of my presentation depends on the showing of a movie, and we have not been able to darken the room sufficiently so that this may be shown properly.

The projector is set up in the back of the room, so if you will, turn your necks while I'm speaking and watch back there. Thank you very much.

The quality of Puerto Rico's coastal waters as a marine environment where a priceless diversity of marine life worthy of study abounds has been the reason why Associated Universities, Incorporated has chosen the southwest coast of Puerto Rico as the best site for the Tropical Marine Sciences Center.

This is after having examined localities on the Atlantic seaboard, the Caribbean and the Pacific. The University of Puerto Rico at Mayaguez, 14 years ago, had chosen the southwest coast, namely La Parguera, for the establishment of its own marine laboratory.

This area represents a unique oceanographic and biological region. The president of Associated Universities, Incorporated, Dr. Keith Glennan, after many conversations with Puerto Rican government officials, addressed the President of the Puerto Rican Planning Board, Mr. Ramon Garcia Santiago, indicating to him that the southwest coast of Puerto Rico had been chosen as the site for the largest and most sophisticated marine laboratory in the world.

In a letter of May 12, 1967, Mr. Garcia Santiago expressed to Dr. Glennan that our government's interest in having Puerto Rico be the site for their project was such that it was willing "to establish orders against the pollution of marine areas where studies are conducted and where the facility is sited."

This was an easy commitment for Mr. Garcia Santiago to make under the protection of Sanitary Ruling Number 127 of 1967, and Law Number 142 of 1950.

However, the Planning Board pays little attention to the Commitment made by its president on behalf of the Puerto Rican government, especially when industry which wishes to establish in Puerto Rico must seek Planning Board permission.

Principally, permission is granted industry once industry commits itself to abide by all present and future legislation against pollution of our coastal waters.

The fact remains that not only does the Puerto Rican Planning Board look the other way, but the Secretary of Health, himself, who has the duty and the power to watch that the water quality establishment in his own sanitary rule, Sanitary Ruling Number 127, be maintained, admits that he has never enforced his ruling and that he is incapable of enforcing it now;

The recent disaster of the Ocean Eagle in San Juan Harbor, where several million gallons of raw pertoleum were spilled, finally convinced a few that the threat of large-scale marine pollution was real and that it was not something that merely happened elsewhere.

Fortunately, the Ocean Eagle disaster was handled in a much more effective way than was the Torrey Canyon. Most of our affected beaches are clear again.

Even here, however, we saw moments of heistation when the owner of the shipment, the two Federal marine agencies, and a local agency fought separately against the oil; in some cases, one group cancelling the efforts of another.

Even today the shore west of Arecibo is still being threatened by oil from the Ocean Eagle because, in spite of our scientists' advice, the oil was not sunk as far offshore as recommended.

Everyone agreed that the condition of our shores during the Ocean Eagle disaster was a tragic one, and that it should not be allowed to happen again.

These are the shores near the region where the Ocean Eagle disaster occurred.

MR. THOMAN: For the record, at this particular point in time, I would like to indicate that disasters such as the Ocean Eagle are extremely difficult to cope with.

In view of the fact that you don't know when they are going to happen or where they are going to happen, to be able to muster men and materials to do a real good job of cleanup is extremely difficult.

But I would like to point out that the Secretary of Public Works sprang into very rapid action, and in point of fact, oil came on the beaches to the east of Arecibo Friday, and I personally saw over 100 men and many, many machines cleaning up out there on Saturday morning.

So I think that in the face of very great adversity, the Department of Public Works did an extremely effective job on their part.

DR. CERAME VIVAS: For the record, the only interest I have in showing this particular movie is the fact that the shores that are being demonstrated here as being affected by a disaster of the magnitude of the Ocean Eagle compare very favorably with the shores along our southwest coast situation, where there is a 24-hour-a-day, every-day condition.

Our oceanographers have carefully examined Guanica Harbor and have found that, aside from the pollution due to toxic substances and suspended solids that reach the harbor, the high temperature of the effluent has generated a very stable condition where a surface layer of warm water effectively blocks the diffusion and passage of atmospheric oxygen into waters below it.

This, of course, has a tremendous effect on the fishes that live there and this condition promotes a smothering by asphyxia of fishes and organisms as well.

The industries guilty of the destruction of Guanica Harbor admit that they are aware of Sanitary Ruling 127 and that they are polluting. They say that to stop pollution would be costly and would place them in an unfavorable position of competition for their product in the market.

Besides, they have never been requested not to pollute, so "why go into all of that expense?"

This that you're viewing now shows one of the open gutters via which flows one of the effluents of one of the chemical concerns in Guanica Harbor. This comes into the bay via this pipe line which we are now looking at which runs under a sidewalk, and it goes right into the bay.

Needless to say, there is very little fishing that goes on in Guanica Harbor, and most of the fishermen that live there have to fish elsewhere. The temperature at this effluent is 28 degrees Centigrade.

A little further to the east of Guanica, larger and more powerful industrial concerns dump into the ocean petrochemical wastes, which are both toxic and of high temperature.

The temperature that one of the effluents reaches the ocean at is 38 degrees Centigrade at a rate of something like 6,000 gallons per minute. One of the petrochemical industries established in Tallaboa Bay has contracted a study of the marine ecological conditions in their area because of public pressure accusing them of badly polluting the environment.

The study in question emphasizes ideal conditions southeast of the effluent opposite where normal currents and drift conditions carry the industrial wastes.

However, the study is very generous in vague statements when it disucsses the areas that are affected by the effluent. The report from this study includes a long list of organisms captured near the area which is totally lacking in specific localities, relative proportions of species, and in conditions of normal species assemlages.

Our ichthyologists have made an extensive study of the area, and they have ample evidence to show that the fish population there and their low species diversity are indicative of very badly polluted waters.

In order to show that the study was done downstream, or rather upstream from the effluent, actually, we did an experiment which is being shown on the screen now.

We have released some dye at one of the petrochemical plants and we are able to follow where the dye goes. Our physiologist has been able to assay petrochemical pollution by means of a precise examination of the behavior of carbonate ions in sea water in the presence of petrochemical compounds and has been able to establish that the amount of pollution in the water of Tallaboa Bay, Guayanilla Bay, and Guanica Harbor have four to five times more organic compounds than the normal amount of organic matter in normal sea water.

He has been able to show, for example, that the concentrations of petrochemical compound carried in the effluent streams of the companies in Tallaboa and Guanica daily are similar to the concentration of petrochemical compounds in solution in San Juan Harbor during the Ocean Eagle disaster.

In January of 1968, the National Science Foundation research vessel "Eastward", operated by Duke University, was made available to our Department of Marine Sciences to make a comprehensive study of bottom conditions along the southwest coast of Puerto Rico from Ponce to Cabo Rojo.

By different means of dredging and bottom sampling, we were able to establish that there is a marked decrease both in populations and species diversity of bottom organisms as one approaches Guayanilla Bay.

In the region of Palo Seco, a liquor distillery and a thermoelectric generating plant dump their effluents nearby.

The region of La Parguera has been designated as Sb under the classifications outlined in Sanitary Ruling Number 127. This means that the waters there shall not contain "floating solids, sedimental solids, oils, and silt deposits attributable to sewage or industrial waters -- sewage or similiar effluents which have not reached necessary purification so that the waters into which they are dumped may be utilized in the manner designated by the uses to which they have been destined."

The Department of Marine Sciences, several years ago, brought to the attention of government authorities that the proliferation of clandestine structures in La Parguera was not only destroying the mangrove, but that the sewage resulting from these 50-odd shacks was degrading the biological environment in the channels.

A government agency informed us that the services of a warden had been contracted and that he would prevent any further construction or the enlargement of the existing ones.

Today 120 clandestine structures and a government-sponsored hotel still dump into the mangrove their untreated effluents. Some of these structures now boast a second story.

We understand that the warden is still on the municipal pay roll. Extreme cases of disrespect to existing laws and natural resources are the pourings of concrete over some of the offshore reefs for the establishment and construction of clandestine structures there.

The Mayaguez tuna canneries who have obtained from the Planning Board permission to operate by guaranteeing their obedience to sanitary regulations are shown here in the process of doing so.

We do not bring to these hearings magic formulas nor voluminous proposals of new legislation to prevent the abuses to which our waters are subject. We merely come here with a plea that the existing regulations be enforced.

Thank you. (Applause)

MR. PAUL TRAINA: Doctor, I would like to ask one question: Does your department have sufficient data on the biology of these waters to give us at least a qualitative description of the various estuarine and coastal waters?

DR. CERAME VIVAS: Yes, we have information going back 14 years.

MR. TRAINA: I would like very much for that data to be made available to us.

MR. THOMAN: Dr. Cerame Vivas, Senor Ramon Garcia Santiago would like to ask a question.

MR. GARCIA SANTIAGO: At the beginning of your statement, you made reference to a letter that the Chairman of the Planning Board sent to Dr. Glennan, Executive Director of Associated Universities, Incorporated, in relation to the establishment of a biological laboratory on the southwest coast of Puerto Rico.

I want to say for the record that the quotation made here is a correct quotation. It is a letter sent, I think, sometine during 1967.

My question is, the cases that you are referring to in relation to the factories authorized and so forth, like the refinery at Guanica, do you know when this factory was established in this area?

DR. CERAME VIVAS: Yes, sir, about 14 years ago.

MR. GARCIA SANTIAGO: Fourteen years ago. Do you know if by then, for example, the quality criteria were enforced?

DR. CERAME VIVAS: No, sir, there were no quality criteria.

MR. GARCIA SANTIAGO: You also mention the fact of La Parguera. Do you know if there has been any recent study completed by the National Park Service and the Puerto Rico Planning Board in order to develop a comprehensive plan to preserve the exceptional quality of beauty of La Parguera?

DR. CERAME VIVAS: Yes, sir, I am aware of these plans, and I have seen them myself.

MR. GARCIA SANTIAGO: Do you know if this report has been completed or if it is in the process of being completed?

DR. CERAME VIVAS: To my knowledge, it hasn't been completed.

MR. GARCIA SANTIAGO: Are you aware of the fact, in order to enforce a plan, you need to have a plan?

DR. CERAME VIVA: My point was that the enfrocement of existing laws not requiring new plants was in order.

MR. GARCIA SANTIAGO: I wanted to make this clarification, because I think that the distinction should be made between a situation that is there, that nobody can deny is existant, and the fact that there is now definite disposition to all action that might be required in order to improve the present situation.

This is only proper in order to five the adequate perspective to visitors from the mainland -- I think you have done well in presenting one point, but I think it is important to present the other point, what action, if any, has been taken for solving these problems in the long run, because none of them can be solved in the short run.

DR. CERAME VIVAS: For the record, I am aware of the interest of many water officials in solving this particular problem, but it disturbs us as a whole that nothing is being done about it in a positive way.

We know of many meetings, we know of many plans, but the actual enforcement of this law that I am referring to, 127, from the Health Department, is zero.

MR. GARCIA SANTIAGO: Do you know, as in the case of the factory that is operating in Guanica, there have been plans forthe discontinuance of its operation?

DR. CERAME VIVAS: Yes, this has been mentioned to me. I understand that the particular installation has had financial problems many, many times in the past and that there is a possibility that they may go out of business completely sometime this summer.

MR. THOMAN: Thank you, again, Dr. Cerame Vivas.

Our next speaker is the Honorable Manuel Mendez Ballester, Chairman of the Natural Resources Commission of the House of Representatives of the Commonwealth of Puerto Rico.

THE HONORABLE MANUEL MENDEZ BALLESTER: I am here on behalf of the Speaker of the House of Representatives of the Commonwealth of Puerto Rico and also as Chairman of the House Committee on Natural Resources.

Puerto Rico faces today a great responsibility and an even greater challenge, the preservation of our natural resources. At present, we are experiencing the effects of the degradation of the environment, which in the future, if no corrective measures are taken, will inhibit the economic and urban development of our Commonwealth.

A dynamic population explosion of an already overpopulated island, a shrinking allotment of space per person, and an increasingly degraded environment will destroy all the efforts that for the last 25 years have been devoted to the enhancement of our living conditions.

Thus, the preservation and enhancement of the quality of the environment is of paramount importance.

It is evident the high degree of pollution in some of our bodies of water, especially the confined waters in harbors, channels, lagoons, and rivers exists.

The sanitation of these bodies of water must be achieved to provide safeguards for the public health, to maintain aquatic life, to preserve the ecological environment required for natural phenomena, such as the phosphorescent bay at La Parguera in Lajas, and to provide for the relaxation of mind and soul of our ever-increasing population.

In San Juan, where most of our population is concentrated, we are faced with a heavily polluted bay, inhibiting its use for recreational purposes, in an area where very little park area is in existence.

The Condado Lagoon, bordered by numerous hotels and apartment buildings, along which many people travel every day, is partially used for recreation, and cannot be used to its full extent because of pollution.

The people who dare to use the lagoon for fishing and water sports do it with great danger to their health, due to the actual levels of pollution in the water.

At par with our continuous urban expansion and industrial development, we must also devote technical and economic resources fro the preservation and reconditioning of our natural resources, if we want to maintain a livable environment for our children and grandchildren.

It is my belief that the rapid increase in mental illnesses, drug addiction, and juvenile delinquency is in great part attributable to the lack of an adequate environment, that may be enjoyed and utilized by the majority of the people without any impediments.

I am completely hopeful that today's public hearing will be a major step toward a joint effort between Federal, Commonwealth, municipal, and private entites for the erradication of pollution in our estuaries and bodies of water, which will eventually lead to great improvements in our natural environment.

Thank you. (Applause)

MR. THOMAN: Thank you very much.

I would next like to call on Dr. Lucila Zapata, who is representing the League of Women Voters. Dr. Zapata.

DR. LUCILA ZAPATA: Gentlemen, I am very pleased to have the opportunity to be here to represent the League of Women Voters, Mayaguez area.

Upon receiving the invitation, I was asked by Mrs. Estrella Fabregas, President of our League in Mayaguez, to represent her. I gladly accepted the responsibility, because I knew that the experience would be beneficial because of what I might learn from the valuable experiences of all you experts in the matter, and because I can later share this experience with the other members of the league and the students under my direction at the Mayaguez University campus.

In reference to the challenging subject of these meetings, public meetings, which include what would be most enlightening in the organization of a program which would include the administration of resources in estuarine areas, I will limit myself to making comments in relation to urgently avoiding, in both short- and long-term plans, the pollution of the above-mentioned area.

It is also important to avoid the excess of sedimentation which, in one way or another, affects the development of the area.

I would also comment on what pollution means for the sanitation in areas which, for their beauty and usefulness, are used for residences, for recreation, and for commercial activities, such as fishing zones, in the estuarine and sport areas in our bays and known by everyone.

If I would go into more details in relation to each of the development areas, my comments would be endless. I will limit them to indicate the importance of the estuarine areas as fishing zones and the negligence due, many times, to ignorance and forgetuflness in the conservation of these areas which affect so much the possible activities of the area.

We know the limitations of the fishing zones in the Caribbean. Factors of a physical nature, such as the location of the region, currents, temperatures of the ocean (80.6 degrees Fahrenheit in the Caribbean), depth, and salt content are some of the factors which affect, partially in a negative way, the development of the fishing zone.

The polluting influences of man also affect the physical environment in the estuary. Man's agricultural activities, industrial development, and development of new residential zones, the incorrect location of municipal waste areas which pollute our rivers, lakes, and bays, are polluting activities of the human element which play an important role.

Lakes and estuarine areas, meaning deltas of the rivers where the effects of the tide are evidenced and where waters of the ocean and river are mixed are very fertile, and with good conservation measures, the highest yield of these regions can be obtained.

Rivers and areas close to them have great mineral resources and contain other nutriends which influence the productivity of their region.

Thanks to the consciousness about this which has been created, a new point of view has been developed. Man's attitude changes.

The most important nations, from the fishing point of view, such as the United States, have many experts studying the important fisheries.

Enormous spawning grounds are maintained, and they replenish the shore line and island's bodies of water. In those regions, fish obtain the characteristics of a culture (aqua culture) and then oysters and other mollusks are planted -- eggs and fish hatcheries -- especially in estuarine areas with fresh water and in shallow bays.

Periodically, the mature fish are captured. The most promising regions for this culture are the bays and the estuarine areas, because the waters are protected and fenced in are accessible from land.

This viewpoint has made the scientists think about the creation of the proper environment for the culture. It is the several governments' responsibility to contribute and establish laboratories and experimental stations in relation to fishing in several areas of the island, such as has been done with agricultural experimentation.

It is also necessary to have and maintain vessels for investigation, trained personnel and technicians who would carefully and continuously evaluate our estuarine resources and who would formulate a plan of action in view of past experiences -- their investigations, observations, or comments of persons interested in these problems.

I regard the scientific investigation and the timely publishing of educational investigations as a very good factor in a project of conservation of natural resources.

I consider myself privileged to have close at hand the resources of the Marine Biology Institute under the direction of Dr. Cerame Vivas.

The Institute of Water Resources, with its capable Director, Dr. Antonio Santiago Vazquez -- I want to thank him for being able to actively participate in the educational programs of the Mayaguez University campus.

But I regret that in spite of all the work being done in this area, we live in an area where the estuarine areas are among the most polluted in the island.

There is an urgent need to heed the observations and recommendations which have been made for the canalization projects, in relation to river bed areas, such as Anasco and Yaguez and Bajura de Cabo Rojo, alarming centers of pollution.

We can state that the real great problem is the education of our people. How many people know what it is about? What responsibility does each of us have in the educational program to avoid the pollution in the estuarine areas?

In outlining a plan of action to administer these resources, we could reorganize our pollution problem Advisory Board to include persons whose agencies are accustomed to polluting and to prevent as much as possible the indirect encouragement of the pollution of our natural resources.

A plan to educate the community in which even our students could suggest some ideas due to the fact that it is their initiative, and this could contribute to a higher degree of appreciation in all that the problem means in a physical environment in which man is the forming agent by excellence.

Thank you. (Applause)

MR. THOMAN: Thank you very much, Dr. Zapata.

Is Mrs. David Chang present, from the American League of Women Voters? Would you care to make a statement?

MRS. DAVID CHANG: Yes. I am Mrs. David Chang, President of the League of Women Voters of San Juan. On behalf of the League of Women Voters of San Juan, I am going to let the Chairman of our Water Resources Committee, Mrs. John Pinto, make the statement.

MRS. JOHN C. PINTO: This morning I am testifying on behalf of the 130 members of the League. Since its inception five years ago, the San Juan League has been studying water conservation and water pollution in the metropolitan areas.

In February, 1968, we bagan a study of the pollution problem of the Condado Lagoon. We have questioned members of the Department of Health, Aquaduct and Sewer Authority, Puerto Rico Industrial Development Corporation, and the Institute of Health Laboratories, all of whom were helpful in compiling the facts I wish to bring before you today.

In the period between February 28 and March 3, we took five samples from the lagoon from two places, Delcasse Street and the dock of the Flamboyan Hotel.

These samples were placed in sterile containers, packed in ice and brought to the Institute of Health Laboratories where they were analyzed for coliform bacteria.

The coliform count considered safe for water used for bathing purposes is 1,000 per hundred milliliters. In all of our samples, the count was over 11 million per 100 milliliters.

An unbelievable figure? No! At the end of Delcasse Street, you can see raw sewage floating into the lagoon. The area is filthy. Toilet paper is caught on twigs and branches; fecal matter is evident; refuse is thrown around; and bugs crawl.

I am sorry that the pictures I have with me are not large enough to exhibit.

As far back as 1953, a study by Dr. Nelson Biaggi of the School of Tropical Medicine showed a coliform count that ranged between 2,300 and 24,000.

In 1967, the Department of Health submitted their own study to the Department of Tourism, showing the coliform count varied between 2,400 and 24,000 and [illegible] that as a result, the lagoon must be classified as very polluted and unsuitable for any use where the body comes in direct contact with the water.

This is an interesting point, as it is obvious that the lagoon has been very polluted for at least 15 years, yet the activity on the lagoon, rather than decrease because of the continued problem, has increased due to the fact that the lagoon lies in the heart of the tourist area, and I am sure many of the users are unaware of the problem.

The lagoon is used for swimming, boating, skiing, even parachuting, and when it is working, a fountain sprays its dangerously polluted water 83 feet into the air.

There are sewers on the Ashford Avenue side of the lagoon, and I understand all the new buildings on the Miramar side must pump their sewage to the trunk line on Ponce de Leon.

The sewers exist. However, apartment houses are discharging directly into Condado Lagoon -- why are they not required to hook up to the existing sewers?

As there is a tremendous need for recreational facilities in the area, it is our urgent desire that immediate action be taken to enforce the law and prevent the illegal discharge of sewage into the lagoon.

We believe the condition is critical and feel it is no longer possible to look the other way. It has been a privilege to testify here today. On behalf of the League of Women Voters of San Juan, I wish to express our gratitude at being able to participate in the hearing and to thank all the government agencies who helped us gather material for this report. (Applause)

MR. THOMAN: Thank you very much, Mrs. Pinto and Mrs. Chang, for being here with us today. If Mr. Gonzalez were here, he might wish to comment on certain portions of your statement.

But I would, for the record, like to indicate that there is an extremely large construction program under way at the present time, and discussions are being held with Mr. Gonzalez a little later this week on future programs in the San Juan area, hopefully that will alleviate some of the problems to which you refer.

There have been some new engineering reports recently received.

I would next like to call upon Dr. E. A. Montalvo Durand, who is representing the Puerto Rico Medical Association. Dr. Montalvo Durand.

DR. E. A. MONTALVO DURAND: Good morning, gentlemen. My name is Eladio A. Montalvo Durand. I am a surgeon and a doctor, past president of the Public Health Council of the Medical Association of Puerto Rico, past president of the American Academy of Neuro Medicine, and I represent both entities.

Before I start reading my pages, I would like first of all to talk about, or inform you, that I was invtied here to present my point of view regarding the optimum steps to be taken for the development of the National Estuarine Study here in Puerto Rico.

I have studied in detail everything related with the pollution of the estuarine areas in Puerto Rico.

In accordance with the invitation which you extended to me to present my points of view on this matter in our island, after studying and discussing in detail this matter with the technicians experienced in this subject, I have arrived to the conclusion that from the point of view of Paragraph 5, Title II of Federal Law 89-753, dated November 3rd, 1966, and from the viewpoint of geomorphology, there does not exist in Puerto Rico areas which entirely match the description and characteristics assigned to an estuary.

In our island, rivers are of a small volume, and in general, do not openly go into the ocean. To the contrary, they stop before they get to shore without greatly affecting the environmental conditions of the area surrounding them.

This is a permanent situation which only changes during the season of torrential rains, when in one or two cases the river discharges its water into the ocean, but this is for a relatively short period of time.

Due to these facts, the situation which could introduce changes or typical and lasting environmental characteristics, is not produced.

On the other hand, the tides in Puerto Rico are low, and for this reason, they do not flood the delta of the rivers nor have any other bodies of fresh water near the coast.

So, the necessary natural condition for the formation of an estuary such as is known in other countries does not exist. Nevertheless, I do not fail to admit that areas such as San Juan Bay, la Laguna Torrecillas, la Laguna del Condado, la Bahia de Guanica, la Laguna Rincon de Cabo Joro, and la Bahia de Jobos have some of the characteristics of the estuaries and suffer the effects of pollution.

The projection of all the surface bodies of water, including the river delta regions and the oceans close to them, from the effects of pollution, is provided for in the program planned by the Health Department.

Law Number 142 of 1950, and Regulation 127, 128, and 129 grant the Health Department legal authority to plan the activities for the protection of all the waters in Puerto Rico, such as subterranean, superficial, internal, and coastal bodies of water.

The activities for the protection of all the waters in Puerto Rico are as follows:

1. Study all the bodies of waters, both inland and coastal, to determine the existing degree of pollution.

2. Carrying out of the permanent sampling operation of coastal waters surrounding the island to determine temperature, dissolved oxygen, acidity, and bacteriological status.

3. Study and investigation of claims and complaints from the part of our affected community.

4. Location of sources of pollution and determination of the necessary measures to avoid or eliminate them.

5. To avoid the pollution by new industries. A coordination has been established between the development company, the planning committee and the Health Department in order to acquire the installation and operation of new industries without their becoming new sources of pollution for the bodies of waters in the island.

6. Educational programs. This activity has been designed so that it will distribute among the citizens knowledge about the importance of our waters for the general welfare and about the dangers which pollution represents to this natural resource.

Suggestions: Besides these activities which are already being carried out, I only have to make the following suggestions for the protection of all the bodies of waters in Puerto Rico to establish an alertness between the medical and the paramedical personnel of the agencies which watch over the health of the people and between the private physicians of each locality to report and identify health conditions, sporadic diseases or epidemics among the people which could be caused by the pollution of these bodies of waters to give the authorities the power to eliminate and control such causes as soon as they present themselves.

The displaying of signs by government agnecies around the bodies of water such as should be protected from pollution in an obvious and general way, so as to avoid contamination, especially by those matters which could affect the health of the population and the animal life in the area.

Conclusions: In Puerto Rico, there are no estuaries, as such. Nevertheless, I have mentioned some areas which, in some ways, have some of the characteristics of an estuary.

For this reason, I recommend that the benefits of the studies which are being planned for these estuarine regions be brought before Puerto Rico to be applied to these areas or other similar ones which are being affected by the pollution of their bodies of water.

Thank you. (Applause)

MR. GARCIA SANTIAGO: Jack, the representative from the Medical Association has brought the problem of the definition of what is an estuarine area. He quoted from the law, and on the basis of the law, he made the statement that he doesn't think that in Puerto Rico there are any estuarine areas as defined by the law.

Yet, he mentioned certain areas which participate of the characteristics of some of the elements included in the definition, and I just wanted to make the statement, and I want you to correct it if you find it inadequate, that this is a study -- the Congress apparently took the position that in the case of any doubt, the doubt should be resolved in favor of considering an estuarine area, certain parts which might necessarily participate of all the elements as defined in the law.

Would you care to make a comment on this, because I think that this is an important point in order to give the adequate orientation to the participants.

MR. THOMAN: Would you care to comment on that, Paul?

MR. TRAINA: The doctor read the legal definition of an estuary out of the legislation that authorized this study, and I believe -- and I'm not a lawyer -- but I believe that the definition does cover all coastal waters, harbors, and bays and all tributaries thereof.

Now, one of the problems that we have had in the past, as far as defining an estuary, is not so much the down end of it, the bay area, but where does it begin upstream.

Now, there could be some legal question here. To the best of interpretation so far, that point is usually where the tide ends or begins, however you want to look at it.

But I believe if you read the law, it would cover all the coastal waters of Puerto Rico.

MR. THOMAN: Thank you very much, Doctor. One question: Did your statement cover Dr. Jose Alvarez de Choudens' -- is Dr. Jose Alvarez de Choudens here? Would you care to make a statement, too?

DR. HOSE A. ALVAREZ de CHOUDENS: I have a statement to make.

MR. THOMAN: Please come forward, Dr. Alvarez de Choudens.

DR. ALVAREZ de CHOUDENS: Good morning. I am Dr. Jose A. Alvarez de Choudens, President of the Puerto Rico Medical Association.

Dr. Montalvo Durand was presenting the views of the Council on Public Health of the Puerto Rico Medical Association.

Modern technology has the object of using the natural resources, converting them in materials, substances, tools, and energy for multiple uses and maximum usefulness.

Once this matter and energy are used, the rest constitutes wastes or undesirable remains that man does not yet know what to do with.

The solution, until now, has been to return this waste to the environment from which it came so that the elements will dispose of themselves in a natural form.

Modern technology has not, as yet, developed the necessary methods for properly disposing of the wastes which humanity produces. The more highly concentrated the pollution is, the larger the pollution potential becomes, especially if the population is organized in a usual way, which means that the people are as close together as possible, occupying homes, factories, public buildings, garages, dry-cleaning plants, and motor vehicles.

The routine urban activities, such as driving a car, cooking out, burning trash in incinerators, or open burning of pastures, and even wastes, accidental fires, motor-operated lawn mowers, et cetera, are source of pollution of the enrivonment.

The amount of water available to dispose of soluble wastes is unimportant. How much air and wind there seems to be to dispose of violatile wastes does not matter.

The capacity of the environment to eliminate waste is definitely limited. Once the natural system of self-purification of environment is over-loaded, the situation of pollution will be created which will undoubtedly produce first, discomfort, damage, and finally, irreparable losses to individuals and the general community.

Unfortunately, the section of the population most susceptible to environmental pollution is logically that of the lowest resistance, such as the chronically sick, the aged, and children.

This group can suffer temporary or permanent damage to their health, while healthy adults do not, apparently, suffer or may suffer from a temporary discomfort.

Once they are created, the problems of environmental pollution have a very difficult solution. The control and prevention of air pollution is not easy.

A coordinated effort on the part of various technical and scientific disciplines is required to evaluate the magnitude of these problems and to determine their ecological impact and design and carry out programs of adequate control and correction.

The sugar and rum industries are the principal sources of waste in the island. At the same time, the requirements for the control of waste in many of the new industries leave much to be desired.

The drainage systems and the means to eliminate wastes are outdated and inadequate. These existing industries, as well as the new ones in Puerto Rico, empty their wastes without any chemical treatment in the nearest stream or on the beach, thus polluting the water.

The waste goes directly to the beaches, where, in general, there are tourists and visitors. These vessels anchored in the parks and bays have the bad habit of throwing overboard the waste and garbage originated onboard.

When the Medical Association of Puerto Rico attended the public meetings held in 1967, in the Health Department on the quality requirements to be met by the coastal waters of the Free Associated State, the Medical Association stated:

> "We understand that the quality control of the coastal waters of Puerto Rico is carried out with an objective of guarding the health of our people.
>
> "For this reason, we recommend that the guarding of our beaches be much more strict and effective. We have the knowledge that in Puerto Rico there are municipalities which have the habit of emptying their wastes on the beaches.
>
> "This waste is, in time, carried by the rising tides and taken to other places, thus endangering the quality of our coastal waters.
>
> "It is due to our climate on our beaches that tourists come to Puerto Rico, and already, on different occasions, they have complained about this in referring to the sanitation conditions, especially after a picnic of our own fellow citizens.
>
> "We recommend more strictness in sanitation laws and, of course, that these disorderly acts be made punishable.
>
> "We are also conscious of the attraction of our phosphorescent waters in La Parguera. The present sanitation conditions, both in this beach and its surroundings, leave much to be desired and also keeps many people from taking their guests there.
>
> "The unlawful construction of cabins and boat sheds close to the phosphorescent waters is well knows. Consequently, the garbage and other wastes of human origin go into these waters and then are carried by the current to other places near these tourist attractions.

"This situation can force this attractive panorama to disappear. We recommend that not only the sanitary conditions of our beaches be intensified, but also beautified.

"The southern industries, such as Corco-Shell, et cetera, must be watched."

The Sanitary Regulation Number 127 recently modified in its Articles II, III, V, and VI (Sanitary Regulation Number 128), demands specific quality standards for the coastal waters of Puerto Rico.

These requirements are transmitted to the industry by our government, and these industries cannot establish themselves in Puerto Rico unless they meet the requirements set out by the Secretary of Health and the Planning Committee.

There are places in Puerto Rico where water pollution has attained, or exceed, the maximum permissible limit. Such is the case of the Bays of San Juan, Mayaguez, and Guanica.

The industrial areas of Puerto Rico, Nuevo, and Guayanilla, apparently present an actual and real problem of air pollution. To avoid an increase in the already-existing pollution and its extension to other areas and its generalization, it is imperative to establish the necessary measures of control as soon as possible and that sanitary regulations, Regulations 127 and 128, be carried out to their fullest extent.

It has been necessary in the past that the administrative organization of the government assume the responsibility of providing necessary resources, both natural and artificial so that our defenseless population of our island could pass from a mere subsistence level to a normal way of life, which includes the right and the possibility of a continuous improvement for each individual.

We believe that at the moment it is necessary to carry out a reevaluation of the philosophy and the future plans of our government to make ourselves familiar with one of the basic principles of the administration of public health services within a system of the democratic government.

This establishes that the government shall provide health services, using public funds in those service areas in which voluntary or private agencies of the community lack the facilities to provide all of these health services.

Actually, in Puerto Rico, there are the technical capabilities, the administrative capabilities, the genuine interests, and the economic means necessary within the voluntary and/or private agencies of the community to develop the medical hospital services on a level with the needs of Puerto Rico.

That which our community lacks is sufficient technical personnel, special equipment, specific assigned funds, adequate legislation, and an administrative organization to face the true reality that our environment is being polluted in an uncontrolled and progressive way, aggravated by an overwhelming growth in our population.

Water pollution; air pollution; unsanitary conditions in restaurants; poor sanitary qualities of milk, meat, and other foods; the accumulation of wastes in yards, sidewalks, avenues, empty lawns, and beaches; free sale in the market of potentially harmful products; the exposure of laborers to health and safety hazards in their jobs; these and several other situations which directly affect health, welfare, and productivity of the population of Puerto Rico are part of the picture in the continuous growth in the environmental pollution in the community.

The control or solution of the environmental pollution problems requires a common, organized effort of every level and sector of the community, especially the effort and the interest of the numerous government agencies which represent different fields of science and technology.

The Medical Association of Puerto Rico offers its unconditional cooperation and admonishes the citizens of Puerto Rico to unite their efforts to face the situation, analyze it, and outline specific actions to be undertaken and carry them out.

Our goal should be to maintain the purity and beauty of our island, encourage its industrial growth without hindering the environment, and using our natural resources to their fullest extent without the penalty of diseases, suffering, and loss of product by the pollution of the environment in which we live.

As a conclusion, we want to repeat the following words by President Lyndon B. Johnson:

> "The science that has increased our abundance can find ways to restore and renew an environment equal to our needs. The time is ripe to set forth a creed to preserve our natural heritage -- principles which men and women of good will will support in order to assure the beauty and bounty of their land.
>
> "Conservation is ethically sound. It is rooted in our love of the land, our respect for the rights of others, our devotion to the rule of law.
>
> "Let us proclaim a creed to preserve our natural heritage with rights and the duties to respect those rights: The right to clean water and the duty not to pollute it; the right to clean air and the duty not to befoul it; the right to surroundings reasonably free from man-made ugliness and the duty not to blight it; the right to easy access to places of beauty and tranquility,

where every family can find recreation and refreshment and the duty to preserve such places clean and unspoiled; the right to enjoy plants and animals in their natural habitats and the duty not to eliminate them from the face of the earth.

"These rights assert that no person or company or government has a right, in this day and age, to pollute, to abuse resources or to waste our common heritage.

"The work to achieve thses rights will not be easy. It cannot be completed in a year or five years, but there will never be a better time to begin."

Thank you. (Applause)

MR. THOMAN: Thank you very much, Dr. Alvarez. Are there any questions? If not, again, thank you.

I would now like to call on Mr. Luis Negron Garcia, Professor of Law at the University of Puerto Rico School of Law.

MR. LUIS F. NEGRON GARCIA: May name is Luis F. Negron Garcia, Professor of Law at the University of Puerto Rico School of Law.and Director of the Institute of Urban Law of said Law School.

I was appointed by the President of the Puerto Rico Bay Association, William Fred Santiago, as the representative of the insular Bar in this hearing. I was also named by the Chancellor of the University of Puerto Rico, Rio Piedras Campus, Abrahan Diaz Gonzalez, to represent that campus.

Lastly, the Institute of Urban Law of the University of Puerto Rico School of Law also received an invitation to participate in these proceedings.

This paper was prepared by the staff of the Institute, primarily Mr. Angel G. Hermida and myself, and is offered in representation of the three institutions mentioned above.

For the opportunity to express our views on such an important matter, I thank you on their behalf.

We have imposed on ourselves certain a priori limitations as to the scope of this paper. First, our analysis will be primarily legal, and we will not emphasize scientific, economic, or factual information.

We shall, on occasion, make reference to facts and other considerations, but this will be only to illustrate some point, rather than to convey comprehensive information.

Secondly, our paper aims to develop some brief recommendations, which we hope will be useful in the preparation of your report to Congress.

Therefore, our focus has been determined by the scope of your investigation, particularly to Section 5(g)(3)(C) of the Federal Water Pollution Act -- hereinafter referred to as the Federal Act -- which refers to recommendations as to the respective responsibilities of Federal, state, and local governments in the control of estuarine pollution.

Consequently, we have not attempted a detailed analysis and criticism of the existing local legal structure functioning and implementation for dealing with pollution problems.

We have made reference to that structure, but only for the purpose of illustrating for you as to its functioning and its inherent limitations.

Furthermore, the comprehensiveness and adequateness of the Federal Act makes it difficult to recommend additions or revisions to its basic conceptual scheme.

Since these hearings form part of the investigation that will result in a report to Congress on the estuaries of the Nation, and since Congress may decide to approve legislation for the control of pollution in such estuaries, it is necessary to briefly make an inquiry into the authority Congress may have to legislate as regards the waters of Puerto Rico.

Congress presumably acquired control over the waters of Puerto Rico in 1898, as a result of the Spanish-American War and the Treaty of Paris.

However, in 1917, Congress -- by virtue of Section 8 of the Jones Act -- ceded its control over "the harbor areas and navigable streams and bodies of water... in and around the island of Puerto Rico" to the government of Puerto Rico.

That same section provided, however, that "all laws of the United States for the protection and improvement of the navigable waters of the United States and the preservation of the interest of navigation and commerce, except so far as the same may be locally inapplicable, shall apply to said island and waters."

In 1950, and by virtue of Public Law 81-600, the Jones Act -- with some changes not relevant here -- was renamed the Puerto Rico Federal Relations Act and readopted as part of the compact between the United States and the people of Puerto Rico, leaving unaltered Section 8 of the Jones Act.

Therefore, it may be reasonable to conclude -- apart from the possible validity of various arguments to the contrary -- that by virtue of Section 8 of the Puerto Rico Federal Relations Act, Congress retained the power to legislate in order to control pollution in Puerto Rico's navigable waters. Estuaries certainly fall within this criteria.

By definition, any river which opens to the sea has an estuary. Not all rivers, however, will have a true estuarine zone. In Puerto Rico, in particular, many rivers will oepn to the sea in such a direct manner, and without the formation of any bay or other system of mixed fresh and salt water, that there will exist no estuarine zone to speak of.

However, some other rivers will form some sort of estuarine zone, from a very simple one, such as that of the Humacao River, to the very complex system of bays, canals, lagoons, marshes, and mangroves around San Juan, into which several rivers drain.

We may obtain an idea of the condition of Puerto Rico's rivers and estuaries by considering the following data taken from Department of Health reports.

The Rio Grande de Loiza, at a point within its small estuary, shows a biochemical oxygen demand, BOD, of 9.4, and a coliform index of 67,800.

The Espiritu Santo River, which opens to the Atlantic Ocean and has extensive marshland surrounding it near its mouth, shows -- at a point approximately one mile from its mouth -- a BOD of 6.8 and a coliform index of 35,827.

Guanica Bay, which is fed by the Loco River and opens to the Caribbean, has a BOD below five and an average coliform index of 6,500.

The Rio Piedras River, which drains into San Juan Bay, shows, at one-half mile from its mouth, a BOD fo 12.9 and a coliform index of 1,560 near its mouth.

It is hardly necessary to add that the above data reflect, in general, rather heavy pollution.

As for San Juan Bay, there exist a series of yearly reports dating from 1963-64. The same testing sites were used every year, so that the data is directly comparable.

Unfortunately, all of the testing stations are on the main bay, and there is no available data as to the connecting lagoons, channels, et cetera.

The data for 1963-64 shows a median coliform index ranging from 10,220,000 to 9,950 and a median BOD ranging from 9.0 to 3.0. For 1964-65, some sites improved, while others grew worse.

The median coliform index now ranged from 1,060,000 to 50,300, and the median BOD ranged from 7.8 to 3.1. On various occasions, however, coliform counts rose to the tens of millions, and BOD rose to 30 and 40 ppm.

By 1964-65, coliform counts very frequently reach the tens of millions, and on various days surpassed 200 million. The highest median value is now 1,500,000.

Correspondingly, the BOD frequently rises above ten ppm during this period. The median value ranged from 9.3 to 3.7.

The largest survey, that for 1966-67, again shows coliform index frequently going into tens of millions and on many occasions surpassing 200 million; and the BOD often going above ten, and in various instances, above 20.

Median values now range from 3,500,000 to 21,500 for coliforms and 9.95 to 3.15 for BOD.

There are in Puerto Rico at least 13 different agencies having some statutory authority over some aspect of water resources. These are the Planning Board, Department of Public Works, Department of Agriculture, Department of Health, Aquaduct and Sewer Authority, Water Resources Authority, Land Authority, Economic Development Administration, Public Service Commission, University of Puerto Rico, and Transportation Authority.

We shall, however, refer only to those that have, or are supposed to have, an important role in pollution control of estuaries.

The first and most important of the Commonwealth agencies that deal with water pollution is the Health Department.

It is the agency specifically designated by law to represent Puerto Rico as regards any Federal program in water pollution control (24 Laws of Puerto Rico Annotated, Section 592) and has general power to establish pollution control regulations in Puerto Rico (24 L.P.R.A. 599).

Its jurisdiction extends over all the waters of Puerto Rico, including the ocean (24 L.P.R.A. 591).

This agency has already submitted to the Federal government water quality criteria concerning coastal waters, as provided in Section 10 of the Federal Water Pollution Control Act, as amended. We shall return to these criteria later.

The Public Works Department also has an important role in water quality problems. It is necessary to obtain a permit from said department in order to extract sand from the sea on the seashore (28 L.P.R.A. 201).

Although this is not in the field of pollution proper, such activity can have a decided impact on water quality of adjacent estuarine areas.

The Public Works Department also has general authority for the draining of mangroves and swamps (28 L.P.R.A. 84 and 12 L.P.R.A. 671 to 678). Again, this can have an impact on adjacent estuarine areas.

The Agriculture Department is in charge of a general erosion control program (12 L.P.R.A. 124). It also has authority over water pollution, and its permission must be obtained as a condition for the discharge of any industrial or agricultural waste into a body of water (1[illegible] L.P.R.A. 61).

This licensing power is expressed in broad terms and roughly parallels that of the Health Department under 24 L.P.R.A. 599.

However, it appears in an article aimed at the protection of fish, crustaceans, and mollusks, and could be interpreted as referring only to the control of substances harmful to such organisms.

The Planning Board has authority to establish regulations for "the development of beaches and other bodies of water" (23 L.P.R.A. 8(11)) and to adopt projects regarding, among other, water resources districts (23 L.P.R.A. 12).

There are a number of other laws which impinge on water use and water quality: the "Water Law", a Spanish law dating from 1879, and made applicable to Puerto Rico by royal decree of April 5, 1886, (12 L.P.R.A. 501 to 1084); Chapters 153 through 161 of the Puerto Rico Civil Code (31 L.P.R.A. 1311 through 1396); the Docks and Harbors Law (23 L.P.R.A. 381 through 434); and several other less important laws.

It should be noted that our constitution also has a provision applicable to the problem at hand. Article VI, Section 19, states:

> "It shall be the public policy of the Commonwealth to conserve, develop, and use its natural resources in the most effective manner possible for the general welfare of the community."

From what was said in Section 111, it is obvious that these various legal instruments have been insufficient by themselves for an adequate control of water pollution, at least with regard to certain rivers and bays.

It is necessary to determine why this has been so, and what can be done to remedy the situation.

One must say, first of all, that there exists in Puerto Rico sufficient statutory authroity for the development of a satisfactory system of regulations and programs for the control of water pollution, with the important exception that the Planning Board lacks regulatory power over the rural zones of the island, a power that is urgently needed.

Also, the multiplicity of agencies having jurisdiction over some aspects of water resources can be a confusing element, and though considerable improvement could be had through a more efficient coordination by the Planning Board of the total governmental effort (23 L.P.R.A. 3), the Secretary of Health has power, under Law 142 of 1950 (24 L.P.R.A. 591 through 601), for the adoption of standards and regulations sufficient to control water pollution in Puerto Rico.

It is misleading, however, to view the problem in such simple terms. It would be easy, but incorrect, to say that the Secretary of Health is solely to blame for the deplorable condition of Puerto Rico's waters.

There are many problems, and water pollution is only one of them, which are not amenable to solution by the simple expedient of laws and regulations.

There are a number of facts, inherent in Puerto Rico's situation, which make the water pollution control problem very difficult. For example, many of our rivers have a very limited flow capacity, in proportion to the number of people they serve.

Of the rivers mentioned above for which low-flow data is available, the Rio Grande de Loiza has a low-flow rate of 37 cubic feet per second, the Espiritu Santo River has 17 cfs, the Loco River dries completely, and the Bayamon River has seven cfs. As a consequence, self-purification capacities are correspondingly low.

Of course, pollution could still be avoided by a) forbidding all discharges into our streams, or b) thoroughly purifying all discharges. For obvious reasons, neither solution is practicable.

Sewage from the cities cannot be stopped, and to summarily forbid all industrial pollution would very seriously impair the industrialization program, which is essential to the island's economic development.

On the other hand, the cost of a massive development of purification facilities is beyond Puerto Rico's budgetary capabilities.

These realities are dramatically revealed in the latest water quality regulations adopted by the Health Department for coastal waters, and which were submitted to the Federal government as provided in Section 10 of the FWPCA.

These regulations, as regard the bays of San Juan, Ponce, and Mayaguez, set no limit whatsoever as regards bacteriological contamination.

Thus, it is necessary to emphasize that emission regulations by themselves will not eliminate the pollution problem facing Puerto Rico's estuaries.

The preparation and adoption of a comprehensive plan for the control of water pollution -- integrated to other policy decisions regarding other natural resources and primarily containing value judgments as to the hierarchy of pure water when confronted with decisions that result in polluting it -- is at the heart of a successful application of the regulatory power.

Thus, on one hand the insular government, through the exercise of the control mechanism, may greatly reduce the pollution of water. On the other, it needs to develop an integral plan -- with detailed programming and fixed priorities -- for the prevention and control of water pollution.

In the latter, regulations will operate within its framework and may certainly be more exitous than functioning alone.

The Federal financial assistance in this basic phase is of utmost importance, for once the administrative structure is set up, research for the identification of pollution problems, their causes, possible remedies, and the elaboration of a comprehensive plan to deal with water pollution, will necessarily follow.

This plan will form the basis for subsequent financial Federal grants, especially for construction works.

Although the Federal Act eontemplates Federal assistance in the preliminary phase of organizing the State Water Pollution Control Agency (Section 3(c)), it may not exceed 50 percentum of the administration expenses of not more than three years.

Due to the importance of this phase, we think a higher percentage would operate as a greater stimulus to the local authorities.

Also, several budgetary limitations might make it advisable to distinguish among the different states according to their financial capabilities. The above is true in the Puerto Rican situation.

Recommendations: From the foregoing, it is evident that Puerto Rico needs help in its battle against the pollution of its waters.

Congress has, in Section 5(g) of the Federal Act, ordered this study of the effects of pollution on estuarine zones, and for recommendation on the "respective responsibilities which should be assumed by Federal, State, and local governments and by public and private interests."

In view of the above, we recommend that:

1. In terms of the exercise of the regulatory power, in the case of Puerto Rico, the direct responsibility for the control of pollution of the estuaries should be at the Commonwealth, rather than at the Federal level.

The control mechanisms must be applied not only at the estuary itself, but all along the rivers which feed it. Thus, the extension of Federal regulatory jurisdiction to Puerto Rican non-navigable waters might be undesirable and may unnecessarily raise a serious problem in terms of the political status question.

2. In terms of financing, the Federal government should shoulder the bulk of the research effort in this area, for any such research will be beneficial to all of the states, the burden should not rest in any particular one.

Thus, the programs provided for in Section 5 of the Federal ct should be greatly strengthened.

3. Congress has already recognized Puerto Rico's limited financial resources in Section 7(b)(1) of the Federal Act by expressly placing the island in the highest "federal share" category.

However, even the proportion there established is not enough for Puerto Rico, particularly as regards a program such as that established in Section 7, whose proper functioning is a prerequisite for participation in the construction grants program of Section 8 and of Section 3(c) that provides help for establishing the administrative structure which will elaborate Section 7 programs and others.

In such a situation, Puerto Rico's severe budgetary limitations could make it very difficult for us to receive the desperately needed aid of subsequent programs.

Thus, in this and any similar future legislation, Puerto Rico should benefit from a higher Federal contribution to any local pollution control program.

4. Lastly, we are of the opinion that the Oil Pollution Act of 1924, should be considerably strengthened. Oil tankers have the potential for discharging immense amounts of pollutants into a bay, as was so tragically demonstrated when the tanker "Ocean Eagle" broke right on the mouth of San Juan Bay just a few weeks ago, spilling millions of gallons of oil into the bay and surrounding beaches.

These are our recommendations. Thank you.

MR. THOMAN: Thank you, Professor. Two comments: One, it is quite interesting to note that you feel that the legal statutory authority for the control of pollution rests with the Commonwealth, and in the third recommendation you recommend increased Federal participation in financing activities and in the construction of needed treatment works.

Let me assure you that the Congress of the United States usually doesn't give money away without exacting some measure of control. In the case of water pollution, they have been trying over the years to see that the states, and in this case, the commonwealth, exercise their correct authority and proper prerogatives.

Unfortunately, the states and the commonwealth have not always exercised their responsibilities. As a consequence, it seems to be a fact of political science that whenever a lower level of government doesn't perform a function, a higher level of government usually steps in and takes over.

I hope that comments of people such as yourself will stimulate the Commonwealth into even greater efforts in this field. Thank you very much.

MR. GARCIA SANTIAGO: Jack, I would like, if I may, to make some remarks on Professor Negron Garcia's statement. As a matter of fact, I must say that I am happy that he has brought some of the statements he has made, and I wonder what -- whether it would be proper for us to ask Dr. Negron Garcia to furnish further statements on the legal aspects he mentioned.

From the viewpoint of the Commonwealth government, I think this is a very important point. I am just wondering if he could submit some further statement trying to rectify the jurisdiction as he would envision it on the light of the assumption that the Commonwealth government should retain jurisdiction over control of the estuarine areas as it regards pollution.

Frankly, I must admit that this is probably one of the most important points that has been brought to our consideration this morning, and I would like that this point might be further explored and a further statement should be submitted to us, if you don't mind.

I think it is very important.

MR. THOMAN: We would be very pleased to have it for the record. We would ask that you get it in to us as quickly as possible, sir.

MR. NEGRON GARCIA: I can submit it and also supplement it with an amortization of this point. Let me point out just briefly that the Federal Water Pollution Act established in Section 10, Paragraph 2, that the primary authority for the control of pollution of estuaries, if not of estuaries proper, of all of the pollutional sources, rests within each state and then establishes a mechanism by which even the state government can deal effectively, according to Paragraph (d), and then the Secretary will publish regulations, and, if necessary, promulgate such regulations containing the standards for water pollution that did not apply in that state.

I think that this is the situation here, also, in Puerto Rico.

MR. THOMAN: May I interject. Did I understand you to say that we were going to set standards?

MR. NEGRON GARCIA: No, I just --

MR. THOMAN: Well, the primary policy in the Federal Act -- it states that it shall be the duty, or the responsibility, of the states to control their own pollution. That is correct.

MR. NEGRON GARCIA: Yes, but if the states fail to do it, then the government establishes the mechanism by which the state can promulgate --

MR. THOMAN: That's correct.

MR. NEGRON GARCIA: That's the situation which also applies in Puerto Rico, except with regard to not having waters that are also covered by the Act or could be covered by the Act, depending on how you define estuaries, as was mentioned before, in Puerto Rico.

Specifically, in Puerto Rico, that would bring the problem of the whole political established question, because, according to the Federal Navigation Act, Congress has authority to retain authority over navigable waters and not over nonnavigalbe waters.

So that was my main line of argumentation.

MR. TRAINA: Professor, I would like to make one comment. I think it would be in order to repeat some of the remarks that Mr. Thoman made initially.

This particular section of this Act, calling for this three-year study; the purpose for it is, at this time, to recommend to Congress how estuaries should be managed and controlled and what the respective responsibilities of all levels of government should be.

Of course, the idea of these meetings is to get expressions such as yours as to what these responsibilities should be so that this information can be given to the Congress for whatever action they may or may not want to take.

So I think we have here in this meeting and in this study a very unique opportunity on all our parts to be involved in planning some long-term control and management programs for estuaries in the country.

MR. NEGRON GARCIA: Well, I would like to mention one last point. I made a difference -- I tried to differentiate between the control power that the states and the Federal Congress has through regulation, and the whole incentive that belongs to programs -- more specifically, to construction works and so forth -- and that difference should be clearly stated, because with regard to construction works, there is clear relationship with regulation.

Secondly, if it doesn't accept the regulation, then that is the basis for the whole construction of works. You won't get it. So it's really a very unique type of relationship.

MR. THOMAN: Thank you. I would next like to call on Dr. Antonio Santiago Vazquez, Director of the Water Resources Research Institute at the University of Puerto Rico.

DR. ANTONIO SANTIAGO VAZQUEZ: I am Antonio Santiago Vazquez. I am Director of the Water Resources Research Institute (IIRA) at the University of Puerto Rico.

The University of Puerto Rico is very honored and pleased by the invitation to participate in these public hearings.

My presentation recommends and collects ideas on the topic shared by Engineer Luis A. del Valle, Professor of Sanitation Engineering of the Department of Civil Engineering of the College of Agriculture and Applied Mechanics (CAAM) and Associated Researchers of the IIRA.

I am Director of the IIRA and of the Civil Engineering Department of the CAAM. We all recognize the great importance of estuaries which abound in the coastal zones of the various continents.

In these areas, estuarine regions constitute a sizable part of the coast. Approximately 80 per cent of the coast of the East Atlantic and the Gulf is formed by estuaries; whereas, in the Pacific they only account for ten per cent.

In Puerto Rico, on the contrary, the situation is different due to the geometrical configuration of our coast, which tends to be more or less straight, and due to the small volume of the rivers, the estuarine areas are tiny.

This states our doubts about the importance of the estuaries, as such. On the other hand, it is fact that our coastal regions, where although in small scale the interrelationship between fresh and salt water still persists, are of a vital importance for the social and economic development of this island and for Puerto Rico life in general.

Due to the above stated, our comments will refer not to the estuaries only, but to out coastal zones in general.

Problems of pollution: An unfortunate consequence of the great progress undergone by the island of Puerto Rico is the pollution of its bodies of water by waste, both domestic and industrial.

Many municipalities still unload their back waters without treatment into rivers and bays. In some areas of our island, it has been necessary to permit a certain degree of pollution by industrial debris for the sake of a greater economic development through the growing and necessary industrialization.

There is no doubt that there exists among government officials and the community a growing concern for the need for natural resources, especially water, to recieve a greater protection than they now receive. if Puerto Rico is to continue to enjoy its present economic development.

The problems inherent to the unloading of waste in the bodies of water are the reduction of the oxygen content dissolved in the water with the resulting death of fish by suffocation, and the toxic substances, the resulting unpleasant odors, the creation of conditions unpleasant to human smell, the pollution of water by organisms which produce diseases, and the destruction of different forms of water life.

These problems are common to both fresh and salt water. The water is thus damaged and the quality requires more elaborate and costly treatments when they are necessary for municipal or industrial use.

The bodies of water which have been polluted by substances harmful to health cease to be available for recreational uses, thus destroying one of the values in which we should be able to count at every moment, which is tourism and also the recreation of the local citizens.

As we have previously stated, there exists in Puerto Rico a great number of towns which discharge their back waters without any form of treatment into the coastal waters close to them.

There are also some rivers which receive back waters of some towns and then pour them into the ocean. A sample of the first situation is Mayaguez.

A sample of the second situation is San German, which discharges its waters into the Rio Guanajibo, which finally unloads exactly in Mayaguez Bay.

The river problem in itself becomes more severe during the dry season, which, added to the particular hydrology of Puerto Rico, creates a situation of extremely small volume, which does not offer the opportunity for the pollutants to dissolve themselves.

These rivers end up by becoming mere sanitary sewers. The Mayaguez River in the west of the island is a sad example of the situation.

Recommendations for the control of pollution for municipal black waters:

1. To control the pollution in rivers, lakes, and lagoons, it is indispensable that plants be provided for the full treatment, including the disinfection of the effluents, for all the black waters which flow into these bodies of water and also for the modification of the existing plants when necessary.

It is necessary to state that even though we admit that the bodies of water have a certain capacity for self-depuration, a matter which is now under investigation by the Institute of Water Resources of the University of Puerto Rico, we can't permit the full use of this phenomenon because our bodies of water are small and the concentration of population and industry grows daily with the pollution.

2. For the pollution control of the coastal waters, it is equally recommended that the black waters be adequately treated before flowing into the ocean.

It is indispensable that this treatment be followed by an effective disinfection, if we want to preserve our beaches in the state of sanitation necessary for their use as a recreational facility.

The adequate design of the hydraulic systems of emission of effluents into the ocean should be taken into account. The most modern methods which are being developed at present should be taken into account so as to obtain an effective dispersion of these effluents into the ocean without the risk of pollution.

This requires hydraulic and hydrographic studies of our coasts to determine currents, temperatures, water density, et cetera.

3. Measures should be taken to increase the low volumes in the rivers during the dry season. This could be obtained through the storage of part of the water during the dry season, and it could be later released in a controlled way during the dry period to maintain an adequate volume at all moments.

These storage basins would also provide water and would raise the level, thus increasing the volume of the subterranean waters. These could be very useful in the solution to the problems of water supply.

This has been done in Puerto Rico in a somewhat limited form, but there is no doubt that this should be expanded.

4. It is necessary to keep the mouths of the rivers open to avoid the stagnation of their waters with the resulting sanitary problems produced by this cause.

The closing of the mouths can be avoided through the construction of jetties adequately designed, or it could be controlled through the periodical removal of sediments which are deposited in the same.

Recommendations for the control of pollution from wastes of sugar mills: In recent years, we have been worried by the nature of the pollution originated by the waste from sugar mills.

This worry is even greater when we recognize the economic limitations in which this industry is developing, which makes it difficult to impose on it regulations which would require the use of purifying equipment which would be, in many cases, sufficiently expensive to aggravate their situation.

It is possible that in some cases the government might have to assume some responsibility with respect to the cost of the purification or disposal of the debris from these mills.

Recommendations for the control of pollution by industrial debris (other industries):

1. It is recommended that studies be made on the possible pollution of waters by the debris from industries which operate in Puerto Rico. This would serve as a basis to regulate the disposal of this waste, both in already established industries and of those which might be established in the future.

2. For those industries which are located in zones where the existance of valuable water resources, such as recreation areas and marine specie hatcheries, would be in danger, we recommend that they be required to adequately treat their debris so as to preserve the natural state of the body of water.

3. In industrial areas, the possibility of utilizing treatment facilities common to all the industries in the industrial complex should be considered.

This would help to distribute the cost of waste treatment, thus making it more economical. With this, the attitude of industry toward pollution control regulations would be improved.

4. Our coastal areas should be zoned in such a way that industrial zones would be separate from recreational areas and bays which have great aesthetic attraction.

So far, industry waste goes into urban surroundings where the laborer lives. Socially, this seems adequate, because it tends to improve the standard of living of Puerto Rico.

Nevertheless, insofar as heavy industry is concerned, the risk of generalizing pollution through the dissemination of these types of industry throughout the island is really alarming.

We should begin to think in terms of transferring the workmen from all parts of the island to the industrial zone by means of adequate mass transportation.

We believe this to be highly feasible, since it is already being done in other parts of the world where distances are much greater. The concentration of heavy industry in one area has another advantage, such as obtaining greater economy and supplying access facilities, water, common treatment of debris, et cetera.

5. Industries should be placed far from areas which might have a great importance from the biological and marine point of view.

6. The location of these industrial areas should be planned taking into consideration the ocean currents so that any polluting agents which by accident might reach the waters will affect as little as possible the areas to be protected.

7. It should be required that industrial wastes be treated completely, taking into account that the possibility of extracting useful substances during the treatment process always exists.

The duplication of the essential equipment is very important, due to the fact that a failure in the equipment should never become a pollution risk.

8. We admit that not all the possible polluting substances can be economically or technically removed in their entirety from the industrial effluents. We also admit that accidents do occur.

From there stems the pressing necessity for the industrial zoning, as we have mentioned in the above statements, and the need to be prepared with the adequate equipment and technicians so that when these undesirable events occur, they can be remedied by the necessary speed and perfection which will evade the development of the problem into an uncontrollable disaster.

Pesticides, weed-killers, et cetera: The pesticides which are nowadays applied to the soil or to the crops generate pollution problems which give us great cause for worry.

While the amounts of pesticides used increase at an unbelievable speed, we also realize the ability that the plants have for concentrating these substances.

The magnitude of pollution of coastal waters, due to pesticides, is up to a certain point unknown and perhaps the most appropriate step to be taken is making an exhaustive study to determine the seriousness of the problem.

We can't forget the constant danger to our limited estuaries and to our coastal waters, the destructive action of man in his plans for expansion and in his programs to claim the land where on one side he destroys mangroves, which could be attractive recreational areas and the favorable environment for the development of marine flora and fauna, but on the other hand he contaminates the environment with the disposal of garbage and sanitary unloading of homes which have been built on the shore lines.

The authorities should also take a stricter attitude against the growing use of our rivers and estuaries as a place for the disposal of waste.

Other more adequate ways should be provided for the disposal of wastes. With the exception of the compost plant which is being built in San Juan, we do not know of any other place on the island where sanitary methods for treatment and disposal of wastes are provided.

Need for research: Every project should be made for the future and should be planned to satisfy future needs. Those projections should be somewhat more than an extrapolation of past situations, of population increase curves, or of socioeconomic or technological changes.

It is necessary to look for new knowledge and new methods. Many research experiences and discoveries can be imported and applied, but the greater part of our problem is typically Puerto Rican -- of an accelerated situation combined with a tropical environment -- and therefore, makes them impossible to be directly applied to Puerto Rico as their methods and experiences develop greatly in the continental states.

What knowledge do we have about estuaries in Puerto Rico? Really, none -- ecology, currents, sedimentation, and hydrological changes.

Recommendations:

1. To provide the IRRA, already established in the Mayaguez campus, or any other organization or group or individual of well-known capacity for scientific research with funds to carry out investigations in the fields of estuaries.

These funds should be provided in various ways. First of all, the Federal funds should be available or they should be increased in any way they can be increased.

2. Matching of Federal funds.

3. To grant research assistantships and research fellowships to graduate students so they can carry out sutdies, either in Puerto Rico or outside of Puerto Rico, in the various fields related to water resources.

4. To sponsor seminars, lectures, et cetera, which might stimulate study and research in this field.

5. To sponsor a local kind of research on individual problems, which would not qualify for other Federal programs.

6. Finally, the approval of something, such as a Water Resources Act, for Puerto Rico which would supplement and, in some cases, complement Federal laws.

Even in a way consistent with our economic resources, the government of the Associate Free States should immediately move in this direction.

In this report we have seen the lack of information about each and every one of the problems here mentioned, and the state of scientific knowledge existing in almost every one of our problems.

Small investments now can offer excellent benefits in the future for the administration and preservation of our water resources, including the estuaries.

There exists in Puerto Rico, the same as in the Federal government, a situation which practically every government agency manages and supervises or in some way has control over one or several phases of the use of water resources in the island.

Experience and logic teach us that in a situation such as this, no matter how efficient the good will of each of these agencies is, it is impossible to have effective administration, effective management, and effective planning.

During and after the '40s, there have been great changes in the socioeconomic structure of the island. These changes demand fewer and more complex responsibilities.

New organizations are necessary to face these new situations. We generally accept that there exist four basic responsibilities for a state which is determined to carry out and develop administration programs for water resources in an organized and efficient way.

These are as follows:

1. To determine the needs of the state in order to provide guidelines toward the establishment of standards and objectives.

2. To provide means for the implementation of standards through state cooperation and coordination with both the Federal and municipal governments.

3. To construct the necessary leagl structure to carry out these demands.

4. To concentrate responsibilities of the development of standards and coordination of programs in only one agency, although other

agencies might be in charge of the management and operation related to water resources.

This state has the responsibility to determine the needs and prepare programs and regulations to satisfy those needs, making the best use of the water resources, such as subterranean waters, superficial waters, coastal waters, et cetera.

For this, it is necessary to have not only the organization, but also the investment of money for the project which might be needed to carry out the programs.

Recommendations:

1. To immediately accelerate the studies which we admit have already begun, to plan an organization which deals with water resources, interior and coastal.

2. Admitting the difficulty in planning an organization which can efficiently function with the government structures already established and involved with water resources in one way or another, we recommend that a working committee be named which, within a reasonable period of time, would prepare a project proposal to create this organization.

3. Among the duties of this organization should be:

   (a) Compile or see to it that facts about water resources be compiled;
   (b) Planning of water resources;
   (c) Development of regulations;
   (d) Effective administration and observation so that regulations and laws will be carried out;
   (e) To maintain the legal aspects under continuous study and adaptation to social and technological developments;
   (f) To carry out negotiations with the Federal government;
   (g) To coordinate local, state, and Federal programs;
   (h) To coordinate research activities with state universities, and sponsor them if necessary.
   (i) To see to it that water pollution control programs are carried out under the already standard regulations.
   (j) To stimulate education in the University in the areas in which the need for personnel might arise, and provide educational programs for the public with the objective of creating a consciousness in the citizens of the problems they have to face in relation to the changing situation such as ours.

Lack of personnel: One of the greatest difficulties of the prevailing situation of the socio-economic and industrial development of Puerto Rico is that a great demand for technical and scientific personnel has been created in areas of knowledge where it didn't exist before.

We have created problems of insufficient use of our water resources, problems of water and air pollution, management needs, and effective administration of our natural resources.

To successfully face these problems, we need scientific and professional personnel. We admit that it is possible to import personnel, but experience has shown that it is difficult to keep them.

It is the job of the University to prepare the necessary personnel to fill these needs, and it is the job of the government to provide funds so that the University can carry out this subservice need.

In the area of natural resources, there is an urgent need to prepare technical and scientific personnel in the areas such as water resources (including sanitation engineering, hydrology, hydraulics, oceanography, coastal engineering, water planning, and geology), as well as in air pollution.

We only mentioned areas related to natural resources, since this area is our responsibility, but there are numerous areas in education which require consideration and study to face the problems which stem from our progress.

Recommendations:

1. Since the need for personnel is urgent, it is at present most important that:

   (a) The University of Puerto Rico, Mayaguez campus, establishes programs oriented toward the preparation of personnel educated in the evaluation and the preservation of our natural resources. In the specific case of water resources, this committee believes that we are at the right moment to offer a Degree in Water Resources, covering the areas of sanitation engineering, hydrology, and all those aspects related to water resources of vital importance to Puerto Rico.

   (b) Since the University has serious obligations already contracted with its people and admitting the present limitation of funds, this committee recommends that sufficient funds be provided to the University so as to carry out the study programs.

   (c) It is the opinion of the committee that it is not only necessary to train technical and scientific personnel, but that it is indispensable to retain this personnel through adequate pay, through encouragement of professional improvement, and through the utmost use of that natural resource, which is our local professional people.

Thank you. (Applause)

MR. THOMAN: Thank you very much, and we certainly appreciate your kind statement.

MR. TRAINA: Doctor, may I ask you one question? Have you or your staff any ideas on the total amount of money that would be required for research in Puerto Rico to look into some of the problems that you have discussed?

DR. SANTIAGO VAZQUEZ: Yes, sir.

MR. TRAINA: Do you have those figures, and would you like to put them into the record?

DR. SANTIAGO VAZQUEZ: Well, it is very difficult to come to any figure, but there is no question but that we need a lot of money.

MR. TRAINA: Would you say it is in the order of a million dollars a year or half a million?

DR. SANTIAGO VAZQUEZ: I don't know. It is very difficult to measure the figure, but there is no question that there is a lot of money needed.

MR. THOMAN: Doctor, would you and your colleagues at the University of Puerto Rico in Mayaguez possibly talk this over and give us a figure in writing as to what you think you could do and what you could adequately absorb?

One of the things, probably, that will come out of this study will be recommendations to the Congress as to some level at which research activities should be funded, and the best advice of people such as you, Doctor, and other will be most valuable to the Congress.

DR. SANTIAGO VAZQUEZ: We will be pleased to do so.

MR. THOMAN: Thank you very much. I think we would like to break at this particular time for about an hour for lunch. With your permission, we will begin this afternoon's session at 1:30

(Whereupon the session recessed at 12:35 o'clock p.m.)

AFTERNOON SESSION

April 22, 1968

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The afternoon session of the public meeting directed toward obtaining contributions from Puerto Rican interests regarding the National Estuarine Pollution Study being conducted by the Federal Water Pollution Control Administration convened in the theatre of the Puerto Rico Bar Association Building April 22, 1968, and was called to order at 1:45 o'clock p.m. by Regional Director John R. Thoman, Southeast Region, Federal Water Pollution Control Administration.

MR. JOHN R. THOMAN: Mr. Passalocqua, are you ready to give your statement in English?

MR. LUIS A. PASSALACQUA-CHRISTIAN: Yes.

MR. THOMAN: Mr. Luis Passalocqua-Christian, representative of Caribbean Development Corporation (CODECA).

MR. PASSALACQUA-CHRISTIAN: Mr. Chairman, chairman of the Planning Board, ladies and gentlemen: Before entering into this subject matter of my statement, it would, I think, be desirable to establish the setting against which the economic corporation which I represent must consider the problem of estuarine pollution.

CODECA is a public corporation of the commonwealth government. Its terms of reference include the rendering of the technical assistance in the economic development of other countries of the Caribbean region, the carrying out or economic development planning on a regional scale, and a development of regional projects and programs of interest to a broad range of countries in the Caribbean, including Puerto Rico.

We do not, however, have a direct part in the internal development and planning for Puerto Rico unless and until such planning extends into the Caribbean area beyond the territorial waters of Puerto Rico.

Thus, the purpose of our exposition today will be to set the question of estuarine pollution in the broader regional framework. In the explanatory memorandum sent to us, with a letter of invitation to appear before this commission, it was postulated that, and I quote, "Estuaries can't be considered apart from their hydrographic basins or their continental shelves".

It is to this premise that we should like to address ourselves and around which we shall develop our thesis. The premise that estuaries can't be considered individually of their continental shelves is particularly germane to the Caribbean.

In this region, we are, as you know, dealing with an archipelago formed by a sunken mountain chain extending from the Yucatan Peninsula to the coast of South America, near Trinidad, with a northerly spur to Cuba.

The continental shelf related to this chain of islands, which, incidentally, is shown on the map in blue, is cut only by a few narrow channels forming a continuous area.

In addition to this continental shelf, the region of our concern presents a foreland of limestone and sediment which links the Caribbean system into another large group of islands outside the mountain range.

Among them, the Bahamas, Anguilla, Barbados, Germuda, Basse Terre exist. As a result of this geographic fact and of further facts, the countries included within this continental shelf are, in general, seeking to climb out of the slough of despondence; that is, partly by developing all of the resources provided for them by a none-too-generous nature, and, being islands, much of their progress depends on maritime transportation and exported trade; so it can easily be conjectured that we are faced with a strange paradox.

One of the few resources readily available to the island, both as food and as a tourist attraction, is fish. It is generally agreed that the depth limit for commercial fishing is the 100-fathom line.

This is shown on the map in a lighter blue. However, since much of the commercial fishing done for local markets is by unsophisticated methods, it generally takes place within the 10-fathom line and close by the estuaries.

This is also shown by the map, but unfortunately, it is so close to the coast line that it cannot be distinguished from where you are sitting.

These estuaries and coastal marshes, including mangrove swamps, play a critical role in maintaining coastal fishery production. To feed the fish population that must provide food for an increasing number of human beings in this region, it takes many billions of pounds of plant food.

This food is produced in the marshes and estuaries, and to a lesser extent, in shallow sunlit offshore waters, all of which serve also as breeding grounds for fish.

Food supply, then, is the key to the question of the value of marshes and estuaries. Food supply for the fish, of course, but ultimately food supply for humans -- that is the key.

If the estuarine and coastal feeding grounds for fish are destroyed, the fish population will dwindle and vanish as it already has in some areas. Loss of plentiful supply of fish has additional meaning if one considers the use of fish by-products as fertilizers and livestock feed.

With this, we have established the first element of our paradox. Now, let us move on to the second.

It is unquestionable that as the countries of the Caribbean progress, port development will have to increase, both in terms of traffic and in terms of docking and industrial facilities.

Because these countries are islands, relatively small islands, the bulk of their trade is maritime. As an example, 60 percent of Puerto Rico's trade moves through the Port of San Juan.

In other areas, the figure is even higher. All countries in the region are now expanding or planning to expand their port facilities. Interestingly enough, most of these ports are to be found off of the Caribbean Sea, rather than the Atlantic Ocean.

Thus, they open onto the wider side of the continental shelf. These ports are now served by approximately 150 shipping lines. The net cargo tonnage moving through these ports, which is increasing at the rate of about three percent a year, represents 12 percent of total world trade.

Increased industrial development has also affected port development in the Caribbean. In some areas, a highly developed industrial complex is rising in port areas.

In others, particularly mining and petroleum refining, or producing areas, the industrial complexes are developing their own port facilities. In either case, estuarine systems are being altered drastically.

Normally, governments have taken little note of the effects of industrial and chemical wastes, to say nothing of sewage which is pumped into the estuarine system.

Normally, the commercial fishing industry, especially where highly industrialized, has raised only feeble objection. This can be understood if one realizes that 95 percent of the annual world harvest of fish, shellfish and aquatic plants, is taken by only 12 countries.

The remaining five percent is taken by some 120 countries. The large commercial fishing fleets roam the globe in search of new grounds as the older ones are depleted.

The small-scale local fisherman is the one really affected and often knocked out of the economy by the loss of his fishing grounds. This, then, is the other element of the paradox.

Let me now cover the ground once again to consider the effects of the paradox. First, all the countries of the Caribbean are interested in the development of a local commercial fishing industry.

As evidence of this interest, many countries of the area, including Puerto Rico, are now participating in a joint program with the United Nations development program and the food and agricultural organization to develop fishery resources and training.

In addition, many areas, Puerto Rico and the Dominican Republic, for example, are attempting to develop fishing cooperatives.

Again, economic assistance and incentives are provided to encourage the purchase of fishing gear and marine equipment, including motors.

Second, most of the countries of the area, particularly Puerto Rico, are at some stage of industrializing and expanding their port areas or creating industrial or mining complexes which require the development of new port facilities.

In some areas, and again Puerto Rico is outstanding, the rapid growth of urban complexes, particularly in coastal areas, is striking.

As a result of these things, the destruction of coastal marshes, mangrove swamps, coral beds and reefs, as well as coastal lagoons and the estuarine system, will be rapid and thorough unless regulated.

In some cases, it is hard to judge the right from the wrong procedures. One can object to water pollution by raw sewage, mining or refining waste, or chemical and industrial refuse, but what about the parallel problem of destruction of mangrove swamps and marshes to eliminate mosquito-breeding grounds and new residential areas, or to expand port facilities?

What about the alteration of lagoons to provide tourist attractions and homes with private marinas, or the destruction of coral beds and reefs to improve harbor and shore approaches, or beach facilities for tourist recreation?

These twin problems of pollution and physical destruction are complementary ones and should be attacked together. I might point out, some things, in the case of Puerto Rico, would appear to stem from the problem.

In the Boqueron area, a once-plentiful oyster-feeding ground disappeared with the draining of mangrove swamps for industrial development. The once enormous land-crab population, which provides one of our national dishes, which depended on coastal marshes and mangrove swamps for much of its food, has dwindled to the point that it may disappear.

The fishing cooperative at Patillas must go far afield as Cayaguas and Silver Banks to the north and Sombrero Bank to the south to obtain sufficient catch to cover their cost and have a meager living.

This calls for arrangements with other governments in whose territorial waters these fishing grounds are.

Distilled to its essence, the paradox comes to this. In order to provide food for a growing population, the countries of the Caribbean must increase their harvest of fish, shellfish and marine plants.

Yet, in order to provide purchasing power and other necessities for this same growing population, there must be a rapidly increasing maritime trade and industrial growth that, by pollution and physical destruction, adversely affect the estuarine system and the coastal waters but must supply the food for the fish resources to be harvested.

The result is the creation of pockets of depression as a traditional fishing community is pushed out of the market -- increased imports of fish and fish products from abroad, using up scarce currency resources.

For example, in 1966, Puerto Rico imported 35 million dollars' worth of fish and fish products and higher prices for seafood and other crops that use fish by-products as fertilizer, including livestock feed, thus raising the cost of living of people whose earnings are meager.

Now, while CODECA has made no in-depth study of the particular problem of the destruction of the estuarine system and its effects on the fishing industry in the Caribbean, the question has come up again and again in the course of our work on maritime transportation, import substitution, port development and industrial development of the area.

The constant liaison with the U. N. fishery program and the Puerto Rican cooperative have also served to alert us. While we do not pretend to have a solution, we feel that there are several steps that can be taken in the right direction at various levels.

At the local level, consideration should be given to the protection of estuaries, coastal marshes and reefs. Destruction for industrial development purposes should be planned and regulated to prevent unnecessary loss.

Puerto Rico is now taking steps in this direction. The other countries of the area must be encouraged to do the same. Industrial development, including the refining of petroleum and mining, should contemplate the safe disposal of waste.

For this, an incentive program at the federal and local level might be considered in view of the extremely high cost of the disposal of these wastes.

Where it is not already being done, steps should be taken to prevent the discharge of raw sewage into the estuarine system.

At the federal level, joint federal and Commonwealth programs should be taken to determine the most efficient method and regulations for the control of pollution in the estuaries and along the coastal waters.

Study programs designed to increase the fishery resources of the island should be undertaken. Among these might be considered the feasibility of seeing new feeding areas outside of present pollution areas.

The results of these works should be shared with the other countries of the Caribbean continental shelf. The possibility should be considered that this work could probably and properly be carried out on a broader scale as a companion project to the Caribbean fisheries program.

It is conceivable that such a venture could be financed by the Federal government, the regional governments, the United Nations Development Program and the Federal Food and Agricultural Organization.

The experience gained in the first four steps by Puerto Rico could easily be made available for such a project. I repeat, in closing, that these suggestions do not pretend to be solutions, but we do feel that they may point the way to one or another possible solutions.

It is, in our belief, necessary, not only for the well-being of Puerto Rico, but for the well-being of other countries in the area, that this paradox be resolved.

May I thank you, Mr. Chairman, for this opportunity.

MR. THOMAN: Thank you very much, Mr. Passalacqua. That was an excellent statement.

MR. TRAINA: One of the pieces of information that the study is trying to get is the economic value of estuaries. Could you make available some estimate from the fisheries standpoint what the potential, say, for Puerto Rican waters is for commercial fishing and how much of that potential is being realized now?

MR. PASSALACQUA: It is my understanding, and I believe that the people at the Department of Agriculture of Puerto Rico have much more information on this than I do, that the commercial fisheries waters off the coast of Puerto Rico are rather limited because of the narrowness of our continental shelf.

I believe it is also a fact that they can substantiate perhaps with more figures than I could that the catch, the fishing catch, off the coast of Puerto Rico, has been dropping from year to year in view of the rather unsophisticated methods.

We have some problem with our fishing communities. It is for this reason that the Department of Commerce, the Department of Agriculture, the Cooperatives' Administration and CODECA have been cooperating in a more sophisticated program with this Patillas fishing cooperative, which permits it to go some 500 miles in either direction in order to obtain a commercial catch.

The problem is one of whether the catch is of such a size as to permit the fishermen to adopt better and more economically viable methods of producing their catch.

MR. TRAINA: Thank you very much.

MR. THOMAN: Thank you, again. (Applause)

I would next like to call Dr. F. G. Lowman, representing the Puerto Rico Nuclear Center. Dr. Lowman.

For those of you who are yet to testify, if you would please -- because we have a sizable group yet this afternoon -- if you could summarize your statement with pertinent recommendations and submit the entire statement for the record, it will be printed in its entirety.

Excuse me, Doctor.

DR. F. G. LOWMAN: Mr. Chairman, Chairman Garcia Santiago, ladies and gentlemen: My name is Frank Lowman. I have lived in Puerto Rico for seven years, and I might say, I plan to stay.

At the present time, I am head of the Radionuclides Division, Puerto Rico Nuclear Center, professor of the University of Puerto Rico.

For the past 20 years, I have worked for the U. S. Atomic Energy Commission on problems in marine contamination by radionuclides, and for the past year, I have conducted a marine feasibility study for the Isthmian Canal Commission and the Atomic Energy Commission on the use of nuclear explosions for canal excavation.

Granted, my experience in pollution has been rather limited, primarily in radionuclides. Concerning pollution in estuaries, for practical purposes, as far as an ecologist is concerned, estuaries are scarce and nonexistent in the Island of Puerto Rico.

However, the water currents around the island are of a pattern that tends to hold surface contaminants near the shore for long distances, thus subjecting the near shore and shore line to actual contaminants.

At the present time, the main sources of contaminants might be listed as: (1) untreated sewage from towns and cities, and this is a bad one; (2) erosion of products from agriculture, and this is a very bad one, although it isn't usually considered as pollution; (3) organic pollutants from ships and landbased industrial plants.

I would like to talk a little bit about these pollution problems, and more about the future sources of contaminants and possible remedies.

In view of the experience of the last two months, I think most of us are currently aware of the fact, or the problem, of petrochemical pollution.

With the increased number of petrochemical plants, we will have increased production of organics that are highly toxic to marine organisms.

On a per-gram basis, almost all of the organic toxicants are more toxic than most of the integrated toxicants. The toxicants from petrochemical plants, the ships that deliver the petrochemical, usually tend to float on the water, thus following beaches, they often produce offensive odors, although these are not limited to petrochemicals.

However, we do now have a drug factory on the west coast that is producing this type of material, and this material is being dumped into the river. We need strong laws, with realistic fines for dumping byproducts from petrochemical plants.

Taxes and fines from this type of law-breaking should be reduced due to preliminary continuing surveys of the environment and the contained biota.

Another type of contaminant from this type of operation is from the ships that deliver the petrochemicals to the plants. Principal release here is oil and tar on the beaches, and although recently it was stated that photo-oxidation, or photo-catalyzed oxidation, will remove this oil from the beaches, our experience has been that this is not so.

The target fleet that was destroyed in 1946, approximately 22 years ago, was completely loaded with oil at the time the fleet was destroyed. Most of this oil was released and ended up on the beaches.

We were back in 1964, and other people were back again this year, and as late as this year, the oil that was released in 1946, is still present on the beaches.

It has turned to rock and has not been removed from the beaches. For safety from oil release from ships, we need laws providing for containment booms.

I think some ships are using these booms at the present time. We need stringent control of maximum ship loading. And these ships that are overloaded should not even be allowed to enter or approach our harbors.

If an overloaded ship does enter a harbor, this ship should be subject to very strong fines. Emergency booms and supplies of oil absorbents with trained crews should be available on the island at all times.

In several of the recent incidences, if emergency booms and oil absorbents had been available in the first 24 hours, the major part of the damage would have been averted.

The second major source of pollution that is likely to increase in the next few years is the increased dumping of raw sewage by cities and towns with increased population on the island.

It's my opinion, and only my opinion, incidentally, from my organization, that sewage treatment plants should have precedence over ball parks, civic auditoriums and ornate monuments, and Federal laws should be enacted to enforce the installation of these treatment plants, provided the local government does not do so.

The third type of sewage that I would like to talk about is that of industrial plant-produced sewage, and this type of sewage should be stringently controlled.

Several local canneries, as of a month ago, were dumping raw sewage into the bay, one of our local bays. However, I would state, in addition to this statement, however, that the damage from the sewage from these canneries, I don't feel, is nearly as bad as the raw sewage that is being dumped by the town at the cannery site.

Other contaminants that will be released into the sea and are being released at the present time are phosphates from detergents, nitrates from industrial plants, fertilizers and from sewage.

In the offshore areas of Puerto Rico, we have large amounts of dissolved silica available in the water. If you produce phosphate, nitrate and silicate in the near-shore marine area, you get high plant productivity.

This is one type of pollution that I don't think is all bad, and I would like to cover this a little bit in more detail later.

There is another form of pollution that is just now beginning to be realized, and this is the future pollution problem posed by thermal output and power sources.

Nuclear power plants will be a reality in Puerto Rico in the foreseeable future. These plants, cooled by sea water, produce large amounts of excess heat, which, in areas of limited flow, might render areas down current unfit for recreational swimming and unfit for growth of resident animals in the area.

With proper design, these plants may be used for power and simultaneous desalination by vacuum distillation. This process removes additional heat from these power stations.

In passing, I would like to state that a nuclear power station produces more excess heat than one operating from fossil fuels, and it is important that this extra heat be gotton rid of before it's dumped back into the sea.

We strongly suggest that multipurpose high-efficiency reactor stations be designed to alleviate the potable water shortage and the thermal pollution threat to our beaches.

I fully expect that within the next ten years we will see at least four large power reactors in a fairly small section of the island.

Another source of pollution is erosion products from mining operations, housing developments and machine farming. In one water shed in Puerto Rico that receives an average of 75 inches of rain per year, approximately ten tons per acre of topsoil is washed off of this water shed.

In the tilled area of this water shed, as high as 48 and a half tons per acre per year of topsoil is washed off into the sea. The mud in the water and the marine water on the west coast results in poor recreational environment for approximately one half of the available beaches.

Now, this is a form of pollution. It has been with us so long that we have forgotten that it is pollution. But at the time the island was covered with forest and not covered with farms, there was a greatly decreased amount of runoff in comparison to what there is now.

The soluble components of river water are low in amount, but the suspended material is high, due to the high average high stream bed gradient and the torrential rainfall.

Flood and erosion control programs should be initiated immediately. This should be done even if condemnation is necessary to get these programs started. We need immediate studies on all major rivers to determine soluble and suspended loads for potential poison elements.

In this connection, I might state that the copper-mining representatives have contacted our group in regard to this type of structure on all the major rivers in Puerto Rico.

So we foresee that these studies will be done.

Another type of pollution which might come to our island which hasn't arrived yet is that of dredge-mining of our island's shelf. About five years ago, we were approached by representatives of a geological survey company regarding the use of our research vessel for deep coring on the island's shelf off the west coast of Puerto Rico.

Upon learning that plans were in the mill to survey for minerals under sediments that were 20 to 30 meters thick in Anasco Bay, we refused to cooperate in this project.

During the past two months, an investigation has been conducted along and off the south and west coasts of Puerto Rico, and these studies were done as a part of the search for submerged mineral deposits.

I am not against mining. I am not against mining the island's shelf. However, I am dead set against mining by dredge-mining. The dredge-mining methods I know, it is necessary to remove the surface sediment before you get to the ore underneath.

If you must remove 30 meters of sediment before you can get to the ore underneath, and pump this back into the water, in limited areas, it is feasible on a daily basis to pump so much sediment into a limited area as is pumped -- as is added -- in an entire year by one of our major rivers.

Strong laws should be enacted completely prohibiting dredge-mining and removal of sand from beaches. The latter practice is still being carried out.

Our research vessels operate off the west coast three or four days a week, and we regularly see trucks removing sand from the beaches. Even with treatment plants, large amounts of phosphates and nitrates will continue to be emptied into the bays.

Increased biological productivity will occur with increased amounts of nutrients. Florida, Louisiana and California are utilizing the increased productivity to increase sport fishing off their coasts through the building of artificial reefs from old automobile and bus bodies.

They dump these bodies into designated areas to provide artificial reefs for commercial fish to spawn and live. The total catch by recreational bottom commercial fishermen may be increased by as much as an order of magnitude -- about ten times.

Federal and Commonwealth cooperation in the removal of transportation eyesores from the land into designated fishing areas on the island's shelf can provide a positive utilization of the increased biological productivity in the near-shore areas, resulting from pollution containing organic nutrients.

These automobile bodies and bus bodies are readily available. One Sunday afternoon in a two-hour trip, I counted 43 along the roads on the west side of Puerto Rico.

If we can get cooperative ventures by the Federal and Commonwealth governments to collect these eyesores and move them into the offshore areas near the island's shelf, I think we can reap some advantages from some types of pollution.

Thank you for your patience.

MR. THOMAN: Thank you very much, Doctor. Any questions?

MR. TRAINA: No.

MR. THOMAN: Next, I would like to call on Mr. Charles Reid, representing the Exchange Clubs of Puerto Rico.

While Mr. Reid is coming up, I would like to note for the record that statements are being submitted from the Mayors Association of Puerto

Rico, from the Ponce Chamber of Commerce of Puerto Rico, from the Federation Nautica de Puerto Rico and from the Puerto Rico Farm Bureau.

Go ahead, Mr. Reid.

MR. CHARLES H. REID: Mr. Chairman, Mr. Garcia Santiago, distinguished panelists, ladies and gentlemen: Before I came over this morning, I realized my knowledge of this subject was very limited.

But I didn't realize how limited it was. I am here on behalf of the Insular Clean-Up Committee of the Exchange Clubs of the District of Puerto Rico, and I would like to thank you for giving me an opportunity to participate in this public meeting to discuss our national estuarine pollution problems as they are particularly related to the waters of Puerto Rico and politically associated offshore islands.

I am confident that ample technical and scientific data will be presented from the group of many capable study panelists, and I will, therefore, leave this aspect to these experts.

My brief comments will be related to local problems of water pollution and pollution control as I see them as a member of a service club dedicated to community service and education.

The problem and control of sanitary and storm waste water in Puerto Rico falls under the jurisdiction of many agencies of Commonwealth and municipal governments.

Storm sewer disposal is generally handled by the Commonwealth Public Works Department, which is divided into seven senatorial districts and 76 municipal or city governments.

Sanitary and industrial sewer disposal is primarily maintained by the Puerto Rico Aquaduct and Sewer Authority, which also provides potable water to most of our Commonwealth communities.

Harbor, lagoon, channel and beach cleaning is done by the Puerto Rico Ports Authority, Ponce Municipal Ports Authority, Commonwealth Parks and Recreation Authority, Commonwealth Public Works Department, bulk-handling corporations, municipal governments and others.

More recently, the U. S. Navy and other Federal and Commonwealth agencies have joined these groups to assist in the emergency "Ocean Eagle" disaster in the San Juan harbor.

We feel, therefore, that a central Commonwealth agency or Department should be established for the study, administration and control of water and air pollution in Puerto Rico in an effort to eliminate the cited overlapping and duplication.

Until this new agency can be created, we would further suggest that closer communication between existing agencies and municipalities be developed with the cooperation and assistance of the Commonwealth House of Representatives Committee for Preservation and Beautification of Natural Resources.

Water pollution is a grave concern to all of us, and it is gratifying to me to participate in a study of this nature and be aware that this mutual problem is being considered and analyzed at this level.

It is my pleasure to pledge the full support of the Puerto Rico District Exchange Clubs to your outstanding efforts. Thank you for this opportunity to be with you.

MR. THOMAN: Thank you very much, Mr. Reid. We certainly appreciate your statement here today. (Applause)

MR. GARCIA SANTIAGO: We have the names of Danibal Charles, Roberto Morciglio and Ernesto Almodovar. Does each one of you wish to make separate statements, or do you have a purpose of making one presentation on behalf of the group?

They all wish to make statements, and they will hand over their statement after they have read it. Then our next speaker is Danibal Charles, from Guanica.

MR. DANIBAL CHARLES: I represent the Committee Against the Pollution of Air and Water in Guanica.

> "The Committee for the Prevention of Air and Water Pollution in Guanica was formed in Guanica in the month of February, 1967, with the firm proposal of finding a solution to the grave problem of water and air pollution, in a democratic way.
>
> "At the same time, they act as mediator between the population of 14,000 and the existing chemical plants.
>
> "Today we will limit ourselves only to the pollution of the coastal water. The pollution in Guanica Bay has existed for ten years, because the Ochoa Fertilizer Plant fills it up with industrial debris.
>
> "The sanitary facilities for more than 50 people discharges directly into the ocean, when there is a boat unloading at the Ochoa Fertilizer dock or the one at Caribe Bay Nitrogen.
>
> "Those sanitary facilities are used by more than 100 additional persons; when washing ammonia, sulfuric acid and soda containers, large amounts of sulphur potassium, urea, superphosphates, and all these are dropped between the boat and the dock during the unloading operations.

"These are rinsed out by pressure and poured directly into the ocean. When the wind in that area blows at a speed of from 20 to 30 miles per hour during the unloading of these substances, vapors are produced which extend all over the bay.

"During the unloading operation of petroleum vessels, and when the tubes are unassembled, petroleum is poured into the ocean.

"Beside Caribe Bay Nitrogen, poured daily into the bay are tons of ammonia water and carbon residues.

"Throughout the years, all of this has brought about a grave condition, the loss of our natural resources.

"Guanica is an historical town, on which the first American troops landed on July 25th, 1898. The appearance of our beach is that of a carbon lagoon.

"We have lost the tourist industry, as boats, yachts and other vessels which used to visit our beach no longer approach it. Besides these losses, the most serious one is the loss of the fishing industry

"Those most affected are the fishermen that not only suffer the damage of their yawls and fishing arts, but they always hopefully and eagerly go out to fish and come back with hardly a catch, and after having gone 12 or 15 miles, only to find the pollution of Guayanilla Bay.

"It is sad to see the disappearance of a way of life provided by God as a support of thousands of extremely poor people in that area. Fishing in that area was possible almost on the very shore, and besides, it was a swimming area which could be used almost the year around.

"All that has disappeared due to the pollution of the waters in our bay.

"This committee is backed by the honorable Municipal Assembly, the State Department, jointly with all the agencies of our government, the Commonwealth government of Puerto Rico.

"We have held meetings with the management of the above-mentioned chemical plants. We have tried to find a solution to this tremendous problem, but we have not arrived at a favorable one, since they claim it is very costly to correct the damage which has already been done and will avoid it in the future.

"We have asked the Health Department to find them a place to empty the industrial debris other than into our bay, but they did not elaborate on that matter.

"On January 3rd, 1968, we had the opportunity of presenting the problem of water pollution to the Committee of Natural Resources and Beatufication of the House of Representatives, and they promised to pass legislation on it and showed interest in finding a solution to the problem.

"The Health Department, which is the agency most directly connected with this matter, claims that it has not had sufficient funds nor technicians to deal with it.

"In the meantime, we have Sanitary Rulings 127 and 128, which are amendments to other rulings by the same department, which are being put into effect.

"This action could have lessened the problem while it was completely being taken care of. The honorable Planning Committee, having knowledge of this situation, recently granted Ochoa Fertilizer a permit to build an annex to the plant which will be used for the manufacture of agricultural fertilizer.

"The population of Guanica was opposed to that project until the existing pollution was corrected, but we were not successful. In the area of the Federal government, we contacted Clean Air in Washington, D. C., and they referred our communication to Environmental Health in Puerto Rico, directed by Mr. Lorenzo R. Iglesias, who claims the same reasons as the Health Department -- 'We have neither the funds nor the technicians for this project....'

"We contacted the Secretary of Interior, Stewart Udall, and he offered to visit Guanica to look closely at our complaints, but later on, he cancelled his visit.

"His schedule for the visit to the Phillip Petroleum would be very short and busy; but he said, nevertheless, that he would come in the future.

"We have been in contact with the Dock and Port Authority, and the United States Coast Guard, and in general, their treatment has been very excellent, since they undertook several inspection trips to our bay, and the last one was carried out by Mr. Lomasney and his staff of the Federal Water Pollution Control Administration.

"Mr. John R. Thoman is very interested in this problem, and he is offering us the best assistance.

"Our recommendations on the problem are as follows:

"1. That the office of the Port Commander be more watchful of the unloading at the Ochoa and the Caribe Bay Nitrogen Dock.

"2. That the Caribe Bay Nitrogen not pour its industrial debris into our bay.

"3. That purifying plants be established and made to purify the water it uses before pouring it into the bay, in case it doesn't find another place in which to pour it.

"4. That our beach be thoroughly dredged and its former condition reestablished.

"5. That the Health Department enforce the laws literally.

"Now, more than ever, the population of Guanica is determined to have the situation corrected, since, in a short period of time, the construction of the southern international airport will be begun, and it is an opportunity for Guanica to grow economically, and we cannot permit the pollution problem to be a main factor in avioding opportunity of reestablishing the tourist trade in this area.

"More important than all mentioned, we seek the general welfare of the town, without opposing industry, whenever it is established with all possible security for the people."

Thank you. (Applause)

MR. THOMAN: Thank you.

MR. GARCIA SANTIAGO: Next is Mr. Roberto Marciglio, who represents the Fisherman Union, from Guanica.

MR. ROBERTO MORCIGLIO: I am Mr. Roberto Morciglio, president of the Fisherman Union, whose membership right now is about 150 members, all residents of the Guanica coastal waters.

Our once-beautiful bay is now suffering daily a serious contamination caused by the throwing of waste and petroleum from the Caribe Nitrogen, Ochoa Fertilizer and W. R. Grace.

This has affected the life of the fishermen who depend on the industry in order to survive. Besides the water pollution, the gases of ammonia and other chemical products are affecting the fishermen who wake up early and have to breathe the contaminated oxygen.

The boats and other fishing gear have been damaged severly, affecting the economy factor of these poor people. They had to spend more money in painting and repairing, frequently, their boats and other fishing equipment.

This situation of water pollution calls for a more direct and serious attention by the government agencies involved with the control of water pollution.

Thank you very much, Mr. Chairman.

MR. THOMAN: How many fishermen did you say were in your union?

MR. MORCIGLIO: One hundred and fifty. That's all the fishermen in the neighborhood of Guanica.

MR. THOMAN: Most of you operate your own boats?

MR. MORCIGLIO: That's right. After two or three months now, the nets have to go.

MR. THOMAN: Thank you very much.

MR. GARCIA SANTIAGO. Next is Mr. Ernesto Almodovar.

MR. ERNESTO ALMODOVAR: My name is Ernesto Almodovar, and I come to these public meetings as a private citizen, residing in Guanica, Puerto Rico, as a person interested in finding a solution to the grave water pollution problem suffered by the Bay of Guanica.

Until recently, this was fundamentally an agricultural country and society, legislation mainly based on agriculture. A very small part ot the legislation answers the needs of an industrialized community.

As indistrialization greatly increases, we find that the existing laws are not being enforced by the Health Department for the protection of our natural resources and beauties.

Industires empty their industrial debris into our beaches, rivers, lakes and all our bodies of water.

Our government never foresaw this industrial growth and never did or presently does nothing to avoid the above-mentioned pollution problem, but, worse still, does nothing to avoid the problem besides attracting industry at any cost without concern for the people's health.

The famous Ruling Number 127 of the Health Department, which outlines the way to control the quality of our coastal water, was never enforced. The fines are so ridiculous that any of those industries can afford the luxury of paying such a fine every day and still operate at a profit.

The cries of the population for rulings and laws to control the pollution of our bodies of water have been ignored. For example:

(1) The case of the tanker "Andrea Palma," which spilled thousands of barrels of petroleum when it went aground near Guayanilla Bay, polluting with oil the beaches of Guayanilla and Guanica.

(2) The more recent example of the tanker "Ocean Eagle," which sank in front of San Juan Bay. What did our government do? Declare itself helpless, since it has no experience to face these cases.

Let us now see some specific pollution cases:

(a) Corco Bahia de Guayanilla, Puerto Rico

(b) Union Carbide, Guayanilla, Puerto Rico

(c) Central Rufina, Guayanilla, Puerto Rico

(d) Central San Francisco, Guayanilla, Puerto Rico

(e) South Puerto Rico Sugar Company, Bahia Guanica, Puerto Rico

(f) Ochoa Fertilizer, Bahia Guanica, Puerto Rico

(g) Caribe Nitrogen, Bahia Guanica, Puerto Rico

All these industries have sanitary facilities without black-water treatment; their industrial wastes, cinders, oil, carbon, chemical substances, are all poured into the ocean, and it is being done with the knowledge of our government.

In this specific case of Guanica, the Caribe Bay Nitrogen pours carbon, solvents, ammonia, acids, daily and directly into the bay.

The South Puerto Rico Sugar Company pours industrial wastes, cinders, scum and thousands of gallons of hot water every minute with acid, calcium, and other chemical deposits.

Ochoa Fertilizer pours industrial wastes into the ocean, and to gain ground, in this they insist, it rinses out their ammonia containers, the vessels and ships which bring sulfur, potassium, urea, and other chemicals for the manufacture of fertilizer, and then the water is thrown into the bay so their boats are clean when they leave our shores to load bulk sugar in other ports of the island.

Speaking to this corporation, the government has gone even further. These gentlemen asked for a permit to enlarge their industrial facilities and a public meeting was held at which the Guanica Air and Water Pollution Committee was present, as well as other committees, and other citizens, among whom this speaker opposed a granting of the permit by the Planning Committee until a study was made to determine to what extent the new facility would pollute the air and water.

That was only a show. The first speaker, an attorney for Ochoa Fertilizer, presented reports to back him up by the Health Department, Dock and Port Authority, Water Works, the Island Firemen Service and the Industrial Development Committee.

The project was approved for the construction of a tank with the capacity of 12,000 tons of pure ammonia in spite of the fact that qualified chemists assure me that in the event of a disaster, whether it be an earthquake or hurricane or tidal wave, it coule cause the death of every living being in a radius of eight kilometers.

This would imply that not a single person would survive in Guanica. It is for the reasons explained above that I believe the public policy of the Commonwealth government on water pollution in Puerto Rico is to attract industry at any cost with no concern for the people's health, since they do not have money, equipment, nor personnel to face such a grave problem.

I respectfully ask that the directors of this program classify my town as an area which requires additional pollution study. Thank you very much. (Applause)

I am willing to submit myself to any questions you may wish to ask me.

MR. GARCIA SANTIAGO: I would like to take this opportunity to ask my friend some questions. I regret that I have to ask them in Spanish, but I will, since the person to whom I am talking has spoken in Spanish.

First of all, you have mentioned the use of the Ochoa Fertilizer Company. I would like to ask you, do you know whether the Ochoa Fertilizer Company of the Caribe Nitrogen Company -- are these two enterprises under one administration?

Do you know whether one owner owns both enterprises?

MR. ALMODOVAR: They have told us that one is a subsidiary of the Caribe -- both are operated --

MR. GARCIA SANTIAGO: Do you know whether the product to be elaborated by the fertilizer in the amplification of the expanding process which has been authorized would improve the actual problem which really is very serious?

MR. ALMODOVAR: I think it is going to aggravate the circumstances, because they are going to continue aggragating fertilizer where they are actually elaborating, and they are going to eliminate chemical fertilizers.

MR. GARCIA SANTIAGO: Do you know whether there would be any improvement in the situation, or do you believe it is going to be the same?

MR. ALMODOVAR: I don't know.

MR. GARCIA SANTIAGO: You mentioned that the government of Puerto Rico has done nothing regarding the other, the "Ocean Eagle" problem.

I believe that what you refer to is that it couldn't prevent what happened to the "Ocean Eagle", in that it didn't take any measures to prevent the bad effects of the spreading of the oil. Is that what you're referring to?

MR. ALMODOVAR: Excuse me, if the government had greater interest --

MR. GARCIA SANTIAGO: So I would understand your position, when you say that the government didn't do anything regarding the "Ocean Eagle", what you were referring to was the work of the eliminating of the oil.

Is that what you were referring to, or are you referring to that it should have been prevented?

MR. ALMODOVAR: What I was referring to is that the government had the opportunity, when the trouble arose at Guanica, to carry out a study.

MR. GARCIA SANTIAGO: No, I am mentioning the "Ocean Eagle".

MR. ALMODOVAR: Yes, but I am trying to answer your question.

MR. GARCIA SANTIAGO: But I want you to answer the question that I am asking you, which is, are you referring, when you mention the "Ocean Eagle", are you referring to the work of accelerating the damage caused by the oil which was spread, or are you referring to the prevention of the "Ocean Eagle" accident?

Which are you referring to?

MR. ALMODOVAR: I am referring to the first one, that the government should have prevented this situation.

MR. GARCIA SANTIAGO: Do you know how much the government of Puerto Rico has spent on getting technicians from the United States Government who sent representatives from the Department of the Interior, and, also, we have used Puerto Rican technicians to deal with the government.

MR. ALMODOVAR: I don't know.

MR. GARCIA SANTIAGO: I don't care to ask any more questions. I just wanted to make this clear for the record.

MR. THOMAN: Thank you very much, Mr. Almodovar.

I would next like to call on Dr. Joseph Peary, representing the Biology Department of the Inter-American University in San Juan. Dr. Peary?

Apparently, he has departed. I hope we get Dr. Peary's statement.

Next, I would like to call on Mrs. Rosa Navarro Haydon, represneting the Garden Club of Puerto Rico.

MRS. ROSA NAVARRO HAYDON: I, Rosa Navarro Haydon, retired professor of the University of Puerto Rico, represent the Garden Club of Puerto Rico, founded in 1933, with the principal objective of "trying to embellish Puerto Rico in every possible way and preserving and protecting its flora and its fauna."

For detailed information in respect to the overseers and members of this organization, please see Annex Number 1.

General recommendations on the pollution of estuarine waters in Puerto Rico:

Recommendations are in reference to:

I. Function and relation of Federal, State and local agencies in the management of estuarine waters:

A. To obtain that all Federal, State and local agencies work together so as to unite their efforts, their financial resources, and their human resources, so as to avoid mistakes by duplication, ignorance or lack of coordination.

B. To see to it that they outline a program which would be the product of the common effort of all these agencies, and with their approval, to consider and make public the socioeconomic and geographic importance of the estuarine areas of Puerto Rico.

C. To see to it that the enforcement of this program be obtained through a total divulgation which would awaken the interest, the cooperation and the enthusiasm of all the citizens of Puerto Rico, affected in their condition as residents of the damaged zones.

D. To develop a program of publication to create interest in the protection and preservation of the estuarine waters of Puerto Rico, we should ask for the cooperation and participation of clubs, such as the Garden Club of Puerto Rico, the Geology Club of Puerto Rico, the Ladies Civic Club, the Club Pro-Improvement and other social and civic clubs.

II. Value of the estuaries:

A. Recreational value:

1. The potential recreational value of various estuarine areas should be made public since numerous zones offer possibilities for the joyful recreation both of children and of adults in urban and rural zones.

Examples: Several bays, Condado Lagoon, the lagoons of San Jose, Torrecillas and Pinones; Rio Arriba and Rio Abajo del Manati, del Rio La Plata, del Guajataca, et cetera, la Bahia Fosforescente and las Bahias de La Parguera, Aquadilla, and San Juan, Fajardo and others; mangroves between San Juan and Dorado and other places, and areas which offer recreational possibilities for boat rides, observation of aquatic and semi-aquatic life, both vegetable and animal.

2. To select specific estuarine zones: shore, lagoons, mangroves, keys and isles, as protection areas or sanctuaries; to stop the disappearance of forms of life typical in these environments.

Examples: Bahia Fosforescente de la Parguera, Arrecifes coralinos de la Parguera, and de las Croabas, Torrecillas, Laguna Cartagena, et cetera.

3. To build walks and paths for pedestrians, cyclists and horseback riders in specific estuarine areas.

4. To build recreational parks in specific estuarine areas.

Examples: The San Cristobal Canyon, the mouth of the Guajataca, someplace in the northern coast between Catano and Dorado, somewhere in the east coast and so forth.

B. Aesthetic value:

1. To take measures in order to make it possible that the scenic beauty of specific estuarine areas does endure.

Examples: Aguadilla Bay; San Cristobal Canyon; the mouth of the Guajataca; Phosphorescent Bay, et cetera.

2. To see to it that the industrial plants which necessarily will be constructed in estuarine zones agree with the nature and the configuration of the surroundings.

3. To prevent or diminish the depressing and unaesthetic effect of existing industrial plants, demanding, through a law, that by means of live hedges, vines and trees, those parts exposed to public thoroughfares be covered; and to embellish the land surrounding said industrial complexes by means of gardens, walks, small parks, fountains of ponds.

4. To demand the repair, the rennovation, and, in some cases, the removal of deteriorated port structures which ruin the appearance of our ports and which could harbor suspicious characters as well as rats, mice and other harmful animals.

5. To preserve in estuarine areas by means of adequate signs, natural features of folklore or historic meaning.

Examples: Spring in Aguadilla, Jacinto in Isabela, section of Anasco River where the Spaniards, Diego Slacedo, died, drowned by the Indians in 1511; Anasco lands where the first sugar mill is believed to have been built in 1533 by Tomas de Castellon; Kings Gardens by the Toa

River; beaches where Indians, English, Spaniards, Dutch, French and pirates landed.

6. To preserve natural features of scientific value, such as San Cristobal Canyon, Cartegena Lagoon, Torrecillas Lagoon, Phosphorescent Bay, mangroves and Tortuguero Lake.

7. To determine which estuarine zones could be developed for industrial, commercial or residential purposes and to regulate their development so as to affect their ecological conditions.

C. Social and economic value:

1. To recognize and make known to the general public the economic value of the sources of water, their volumes, the distribution, their control, their treatment and their domestic, industrial and agricultural uses.

2. To make public the importance of rivers and other estuarine zones as natural environments for fish, oysters, crabs, shrimp and other forms of sea life which are used for food.

3. To make known the role of rivers and other currents as vehicles which carry various materials as rocks and organisms which cause diseases, such as dysentery, typhoid fever and others.

4. To make known the function of rivers and coastal waters as geological agents which modify the surface of the earth, forming grounds, transporting soil, depositing soils, forming meanders, deltas, caves and transforming beaches, et cetera.

III. Damages produced by estuarine pollution: The various damages caused by polluted waters are of general knowledge.

1. Human health. Puerto Rico's overpopulation, its increasing industrial progress, the lack of appropriate control measures, the general ignorance of the importance of water are factors which contribute to the daily-increasing pollution of its estuarine waters.

It is strange to find a river or brook which does not receive waste of the domestic, industrial or government origin.

Examples of this are: Usabon River, in which the municipalities of Aibonito and Barranquitas use the most beautiful part of San Cristobal Canyon, the largest geological canyon in Puerto Rico, use it as a city dump; the Toro Negro de Villalba River, which a bridge will be innaugurated over in April of this year, 1968, next to a dump which exists a few yards from it.

The following is a quote from the "El Mundo" newspaper, April 6, 1968: "Condado Lagoon ... in which the water is not adequate for any use in contact with the human body".

Recommendations:

1. To purify or adequately treat the residues, whether they be black waters or any other nature, before they reach the bodies of waters, without which they will be forbidden to be unloaded in the estuarine waters.

2. Try to remove the effects harmful to smell and sight, of residues to be unloaded in estuarine zones.

3. The economic effect of polluted waters is obvious, since many people live in fishing and coastal estuaries. Polluted waters usually cause the death of considerable amounts of fish.

Examples: Article in "El Mundo," August 19, 1967: "Thousands of dead fish in Rio Canas." It is known that someone washed drums containing chemicals; it is known that on one occasion a plane apparently sprayed weed killer on river waters.

Another economic result is the depression of property in estuarine areas due to the misuse and rundown condition of lands, bordering rivers and bays, producing urban ills and economic losses.

Recommendations:

1. To rennovate and rehabilitate the dock area, so that instread of its being a dirty and outdated entrance to old and beautiful San Juan, it will be converted into an attractive and well-planned architectural complex in which the panoramic and geographical qualities offered by San Juan today are taken advantage of.

2. To improve the sanitary service in the port zone and land, as well as the bay water.

3. To prohibit the establishment of industrial or municipal dumps in land adjacent to rivers, bays and other estuarine waters.

4. To enhance the scenic beauty of San Juan Bay, creating facilities such as parks and walks, tree-lined walks, sidewalks for pedestrians, bicycle paths, small docks for boats used for riding or fishing along the coast, benches from which to watch the port movements, watch the sunset, the enraged or quiet sea, et cetera.

5. To attain greater coordination, cooperation, and union of funds and human resources with the objective of integrating all the government agencies and affected private interests, for the welfare of the society of Puerto Rico.

6. To demand that buildings to be constructed and port areas and estuarine zones, both urban and rural, be in harmony with the beauty of the place so that they enhance its harmonic value.

IV. Other recommendations: In my opinion, one of the most vital needs to obtain a greater preservation of our estuarine waters and the forms of life existing in them is a necessity of an educational nature.

It is absolutely necessary to educate at every level inside and outside the classroom, around the beauty and importance of our estuarine waters, to develop an appreciation towards them so that that will be known, protected and preserved better; to see that our child and adult population adopt an attitude which will result in the development of civic conscience, cooperation, pride, dedication, effort and sacrifice of individualistic tendencies, will contribute to the preservation of our estuarine areas for the present and for the future.

As a means of education, besides science and social studies courses, from kindergarten up to the university level, educational programs through newspapers, television, movies and hikes are, as we know, of great value.

Contests, dramatizations, maps, graphs, posters and other visual aids are of great educational impact.

I also recommend the compilation of studies, research, documents, monographs, pamphlets, photographs and articles which refer to estuarine waters and their availability to the public to increase their knowledge, since this would contribute to a greater information for the people about these areas and the problems that affect them.

To develop a better program which would regulate tre disposal of industrial, municipal and domestic wastes, taking into account treatment of waste before being poured into the ocean; specific places in which they can be emptied; means of emptying them (hydraulic, mechanical and others); establishment of treatment plants for black waters; personnel trained in the operation of treatment plants who would know about the operating and functioning of those plants, but also the social importance of its correct operation, penalties for violators of the regulation; revision and amendments of the water law in view of the present needs of an overpopulated Puerto Rico, which is being industrialized at an increasing speed, and still sensitive to the natural beauty of its surroundings, and in view of the most recent technological and scientific findings.

To attain the reunion of all possible uses for lands, bordering the rivers, so as to contribute to the enhancement and protection of our estuarine resources and to avoid misuse and waste of same.

To leave untouched specific estuarine zones so that the ecological balance will be reestablished and so that some already scarce forms of life will not be extinguished, and so that places of special natural beauty will endure for the benefit of future generations.

A mangrove with its exotic aerial roots and its entwined natural branches produces beautiful effects of light and shadow on the waters from which they stem, and besides, offer adequate shelter for numerous birds, such as herons, wading birds, mangrove chickens, ducks, which are almost extinct, and the African heron.

To preserve the vegetation which grows alongside rivers and streams, such as la guajana, Eneas grass, bamboo and various trees which, besides avoiding erosion, in case of overflowing of rivers, offer shelter to birds such as mozambique, turtle doves, redfooted thrush, nightengales and others.

To make a census of aquatic and semi-aquatic birds and accordingly revise the hunting law.

To print and distribute phamplets in which places of beauty or singular importance are described in estuarine zones which deserve to be visited and known by residents and visitors.

To prohibit the extraction of coral, to preserve the bordering mangrove of La Parguera, isles and keys and of Phosphorescent Bay.

To prepare educational walks in which properly labeled diagrams would appear, indicating the form of life found in the surroundings, such as in the La Parguera Bay; such as oysters, anemones, sea urchins, starfish, snails, clams, sea worms, fish and coral.

To maintain the natural balance in the waters of Phosphorescent Bay, avoiding even the slightest environmental changes, as it is not known how they could affect in a detrimental way the bioluminiscent organisms which live in it.

To make known to the public the submarine gardens in estuarine waters, such as those in La Parguera, Las Croabas and Boca de Cangrejo, conducting boat tours under the direction of qualified guides.

To incorporate the facts and examples pertaining to estuarine zones of Puerto Rico into textbooks and other biology, geography, and history school publications.

To recognize the need for Puerto Rico to have more hydrologists and other scientists reside in the country who could devote their time to taking care of the numerous problems related to our estuarine waters.

To promote the interests of our students and make them familiar with new educational fields, such as hydrology, marine geology, and marine biology and others.

In the face of a specific population and rapid industrial growth, a lack of territorial extension in natural resources, Puerto Rico has a need to reduce the social costs of the pollution of its estuarine waters, to recognize their geographical importance and to put into practice, even in small schools, all the possibilities to growth and elevate the environmental conditions.

Thank you. (Applause)

MR. THOMAN: Thank you very much. Next, I would like to call Mr. George A. Seiglie, representing the Department of Geology at the University of Puerto Rico.

Professor Seiglie? He apparently has left.

Are you Mr. Gelabert?

MR. PEDRO A. GELABERT: Yes.

MR. THOMAN: Mr. Pedro Gelabert, representing Social and Geological de Puerto Rico.

MR. GELABERT: Mr. Chairman, chairman of the Planning Board, ladies and gentlemen: On behalf of the Geological Society of Puerto Rico, I wish to enter the following brief statement into the record of this meeting.

The Geological Society of Puerto Rico is a nonprofit scientific and professional organization, the membership of which includes most geologists resident and working in Puerto Rico.

An appreciable part of the coast line of Puerto Rico and adjacent inland areas may be included within the estuarine zone, as it is defined in Title II of the Congressional Act authorizing this and similar meetings.

Processes that are characteristic of estuarine zones fall within the purview of a number of scientific disciplines, not the least of which is geology.

The principal geologic processes that take place in estuarine zones include erosion, sedimentation and induration in a variety of chemical and physical forms and in continuous and intricate combination.

At most times, such processes proceed in small increments not readily discernible on a day-to-day basis, but occasionally there occur incidents best termed catastrophic that produce striking geologic changes over short periods of time.

Such incidents include hurricanes and their attendant high winds and seas and heavy rains, that can accelerate geologic processes and cause substantial modification of an estuarine environment.

A recent catastrophic incident was the short period of extremely heavy seas early last December that resulted in considerable shore line damage from place to place and in frequent wetting by salt water of areas not normally so exposed.

In sum, geologic processes are among the chief actors where sea and land, thus salt water and fresh water, meet, so estuarine and other coastal zones are legitimate areas of geologic concern.

And as Puerto Rico's coastal areas are of great economic, scientific and cultural value, the Geological Society of Puerto Rico considers that studies in these areas would be incomplete and unsuitable from the point of view of Puerto Rico without due consideration of geological factors involved.

We urge that your report include a recommendation that geological studies be required features of programs dealing with the resources and problems of estuarine zones.

In urging this, however, we wish to make clear that we are not merely promoting the fortunes of the Geological Society of Puerto Rico and its members.

There presently is more work here than can be done by geologists now in Puerto Rico. We recognize that for at least the next decade or more, most geology in Puerto Rico will be done by geologists from elsewhere.

In closing, the Geological Society of Puerto Rico wishes to offer the services of its Council and membership for advice and consultation on geological aspects of estuarine studies in Puerto Rico.

With the permission of your committee, the Society wishes to submit a technical report at a later date dealing with the geological factors and problems that might affect the pollution of estuarine systems. (Applause).

MR. THOMAN: Thank you, Mr. Gelabert. Will the Society's report be available within two weeks?

MR. GELABERT: We will try to have it in two weeks.

MR. THOMAN: It is possible that we could delay an extra week, but we do try to get the transcripts out as quickly as possible. We will look forward to receiving it. Thank you, again, sir.

I have cards here from two ladies, Hilda F. Torres and Cecilia S de Alfano, representing the Costa Azul Luquillo. Are they in the audience? Apparently they have departed. They indicated this morning they wished to speak.

Is Mr. Donald S. Erdman here from the Commonwealth Department of Agriculture? There was a question as to whether or not -- Mr. Erdman?

MR. DONALD S. ERDMAN: I am available if anyone wants to ask questions.

MR. THOMAN: I see. I think Mr. Garcia Santiago is going to ask the Secretary of Agriculture to submit a report for the record. Thank you, sir.

Next, I would like to call Mr. Frank H. Wadsworth, representing the Natural History Society of Puerto Rico. Mr. Wadsowrth.

MR. FRANK H. WADSWORTH: My name is Frank H. Wadsworth. I represent the Natural History Society of Puerto Rico, a group of 80 citizens interested in the conservation and education of the public concerning natural resources, and I also represent the Puerto Rico Council of the Boy Scouts of America.

Mrs. Haydon covered so well some of the natural features of the natural features of the estuarine zones that I, in the interest of time, am going to shorten still more of what I had to say.

Puerto Rico estuarine zones, including salt marshes, intertidal areas, bays, harbors, lagoons, inshore waters and channels, as defined in Public Law 89-753, are extensive.

Coastal lowland soils characteristic of such areas cover about 67,000 cuerdas. Lagoons, estuaries and protected bays add about 18,000 cuerdas of water surface, or a total of about 85,000 cuerdas of estuarine zones.

Within these zones are some 500 kilometers of shore line, enough to encompass the entire island.

Topographic maps of Puerto Rico show 62 distinct estuarine zones of 20 cuerdas or more in area. Along the north coast there are 23, on the south coast, 18, on the west coast, six, and on the east coast and Culebra and Vieques Islands, there are 15.

In approximate area cuerdas, the largest areas are as follows: Torrecilla-Pinones, 5800: Jobos Bay, 5300: San Juan Bay, 4300: Guayanilla Bay, 2800: San Jose Lagoon, 2400: Tortuguero Lagoon, 2300.

Nine estuarine zones are of more than 1000 cuerdas in extent, and 46 are more than 100 cuerdas. Six of the largest each have more than 1000 cuerdas of land area and 15 kilometers of shore line.

Forth-eight have open water, of which 21 have more than 100 cuerdas, and four have more than 1000 cuerdas.

The estuarine zones of Puerto Rico have been used since the first days of settlement. Columbus is believed to have drunk water from one in

1493. The protection these zones afforded ships first made possible the settlement and later made necessary the defense of the island.

Today they are vital to commerce and transportation and important for tourism, boating, fishing and shellfishing, and the extraction of salt.

Our use of estuarine zones has modified them. Open water areas have been dredged and wharfs built to accomodate shipping. From the land side, about 50,000 cuerdas of mangrove, or three fourths of the original mangrove area, have been destroyed, including their complete elimination from 13 of the 62 estuarine zones.

Most of this area has been drained and used for agriculture, but part is now urban. Roads, ditches and land filling have changed the water level. Extraction of sand from foredunes which formerly protected estuarine zones has in places exposed mangroves to the full destructive force of the sea.

The lagoons and mangroves, looked upon as ill-smelling bodies of water surrounded by foul, impenetrable morasses of ooze teeming with all sorts of creatures and mosquitoes, have appeared to deserve our trash, garbage and sewage.

The estuarine zones of Puerto Rico could be made much more useful and attractive than they are at present. Commercial and industrial uses of the areas can be expected to increase.

Fishing and salt extraction are of continuing importance. The interest in boating and tourism in these areas is only beginning to develop. The potentialities of recreational use of the mangroves for their natural beauty, bird rookeries and their interesting plant life have hardly been given thought.

The public must take a growing interest in our estuarine zones. Particularly is it important that there be a general understanding of the critical relationships between land and water in these areas.

The fact that mangroves build up and stabilize estuarine shores, and, in fact, actually produced the 50,000 cuerdas we appear to have "reclaimed" from the swamps must be recognized.

The need for conservation of estuarine zones is greater than ever before. Pressures to change or destroy basic natural features of these areas are growing.

Swampy areas are considered undeveloped and, particularly near cities, are looked upon as something to reclaim, whatever the cost.

Although much of the coast line and about half of the remaining mangroves are publicly owned, most of our estuarine zones are in private ownership and subject to little or no guidance for development in the public interest.

Our only conserved estuarine zones are the 8500 cuerdas of mangrove which, as state forests, have been protected for more than 50 years. However, even these lands are now subject to planning for purposes which conflict with their conservation.

The interests of the two organizations that I represent are mainly with the conservation of the attractive natural features of our estuarine zones. We recognize that further modifications of some of these areas may be necessary.

We believe, however, that all future development of these areas should be in accordance with plans in the long-range public interest. We believe that toward these ends, the following should be done:

1. Make an inventory of our estuarine zones to determine their values for all prospective uses, including enjoyment of their natural features.

2. Identify those specific estuarine zone areas where natural features should be of primary interest, and especially areas such as the Phosphorescent Bay, where such features are in jeopardy.

3. Conserve important natural features of our estuarine zones by continued protection of those 8500 cuerdas of mangroves in state forests and public acquisition or zoning of other critical areas against adverse development. Utilize all available Federal assistance for these activities.

4. Expand investigation of the natural history of our estuarine zones, including relationships between land, water and animal and plant life. Publicize the results to improve public understanding of the importance of conserving the natural features of these areas. Solicit outside assistance to share the support for this program.

5. Encourage rational use of mangroves by Puerto Ricans and visiting tourists, and especially by schools and other youth groups for their recreational and educational values.

Simple, well-planned facilities for access, which neither destroy the natural character of the mangroves, nor attempt to provide mass recreation, are needed. Boating tours in the Torrecillas Lagoon area appear to be a good prospect of this type. (Applause)

MR. THOMAN: Thank you very much, Mr. Wadsworth. Mr. Traina would like to ask you a question.

MR. TRAINA: Mr. Wadsworth, we are, again, in the National Study, trying to get some ideas' of the zones throughout the country. Could we get a listing from you of the 62 zones and some geographic descriptions as to what they cover?

MR. WADSWORTH: I would be very happy to do this. I must admit, under pressure, the study was made on the basis of a grid analysis of topographic quadrangle maps and is subject to an individual basis to some error.

MR. TRAINA: We would like to get as much information as we can to make some judgments as to where the estuarine zones are.

MR. WADSWORTH: I would be glad to send you a map and what data I have.

MR. THOMAN: Thank you, again, Mr. Wadsworth. We appreciate your being here.

Is Ernesto Mieres Calimano here?

MR. ERNESTO MIERES CALIMANO: Yes.

MR. THOMAN: Would you please come forward?

MR. CALIMANO: Please allow me to make my statement in Spanish. My name is Ernesto Mieres Calimano. I am an adult, married and am a lawyer. I live at Number 1 Taft Street, Apartment 10, A Condominio Playa Grande de Santurce, Puerto Rico.

I appear at these meetings in answer to an invitation extended to me by the Honorable Roberto Sanchez Vilella under the direction of John R. Thoman.

I make this appearance as a citizen interested in the solution of all the problems which might affect Puerto Rico. Among them, and of the utmost importance, the great water pollution in our rivers, as well as in our beaches, and as president of the Association of Property Owners of Brenas, Dorado, Puerto Rico.

In accordance with that required in the outline given to me, I have sent a copy of the statement I would present here to the Director of the Technical Program of the Southeastern Water Laboratory, Federal Water Pollution Control Administration, in the city of Athens, Georgia.

The Association of Property Owners of Brenas, Dorado, Puerto Rico, is a group of owners of houses on the beach, which was organized with the main objective of preserving the Brenas Beach, which was totally destroyed by the unlawful construction of a breaker by the Dorado Beach Hotel, and among its members there are doctors, lawyers, engineers, businessmen, manufacturers, all individuals of great prestige and worth in the community of Puerto Rico.

We have always endeavored for the preservation of our beaches and to avoid water pollution. A few years ago, the Dorado Beach Hotel closed the Mata Redonda Lagoon and installed a pump to extract the water when its level rises and unload that water in the ocean.

This water is polluted by all the insecticides used by the hotel for keeping the lawn and the golf course. For a few years, we have always been noticing the presence of petroleum in the beach waters, a fact which we brought to the attention of the Honorable Guillermo Arbona, Secretary of Health, December 7, 1965, and to the attention of all the government agencies.

We present a photocopy of the letter addressed to the Honorable Secretary of Health and a photocopy of the letter sent to us by Mr. Ruben Sanchez, Administrator pro tem of the Administration for Economic Development, in which it is admitted that through a technical report by the Section of Minerology and Geology, it has been discovered that there are insecticides in the Mata Redonda Lagoon and crude oil in the waters.

In the letter which we addressed to the Honorable Secretary of Health, we make known to him the burns suffered by my daughter Enid, age 14 at the time, and the skin rash suffered by a daughter of Dr. Arturo Flores Gallardo.

In that letter we asked for an investigation of the procedures of that oil and the avoidance of the unloading of those polluted waters from the Dorado Beach Hotel which were harmful to the health of the persons who used that beach.

Copies of those letters were sent to Mr. Ralph Durand, Administrator of Economic Development, and to Mr. Ramon Garcia Santiago, President of the Planning Commission of Puerto Rico and also to Mr. Hector E. Pineiro, Director of Tourism.

In May of 1965, I was forced to send a telegram to the Honorable Miguel A. Hernandez Agosto, asking for an investigation due to the fact that thousands of fish were found on the beach.

The Honorable Secretary of Agriculture never informed me of the results of the investigation undertaken by his department, if one was ever undertaken, and he limited himself to sending me a photocopy of a telegram which he sent to the Honorable Secretary of Health, informing him of the complaint I had brought about in reference to destruction of fish life.

As a result of a complaint sent to the Secretary of Health, about the pollution of waters by the Dorado Beach Hotel, dated May 13, 1966, I received a letter from Mr. Rodolfo Lara, head of the Water Pollution Control Program, photocopy of which I present here, and which I was told that as a result of the pertaining study and interviews with the preservation engineer at the hotel, they promised to discontinue the unloading of the waters, both from the houses belonging to the hotel seashore, as well as of the lagoon within the hotel property.

Due to the fact that the water pollution continued to the extreme that many people suffered infections and others were admitted to hospitals, we again insisted on an investigation of the beach waters and on February 15, 1966, Dr. Fernando Padro, Director of the Health Department (pro tem), addressed a letter to Mr. G. Bland Hoke, general manager of the Dorado Beach Hotel, informing him of the investigation conducted on the water pollution in Brenas and the presence of oil in the waters unloaded from the lagoon and the difficulties as known (pesticides) found in the lagoon waters.

These investigations were carried out by the Institute of Health Medicine of the Medical Center of Puerto Rico. A photocopy of the letter is included and is part of this statement.

In spite of all the steps taken in the past three years, we have not managed to attain the discontinuing on the part of the Dorado Beach Hotel of the unloading of those polluted waters which reveals a lack of coordination existing between the agencies which deal with this problem.

We trust that once all the facts which contribute to the pollution of waters have been studied, legislation will be passed in a way to avoid the enormous pollution of waters. Thank you. (Applause)

MR. THOMAN: Thank you very much. We appreciate your statement.

I was saving the last place today for a good friend of mine, Mr. Ramon Guzman, but I understand his boss is here. Professor Biaggi, would you like to make a statement? You have precedence over Ramon.

MR. GARCIA SANTIAGO: I would like to say that the statements Mr. Calimano has made are completely new to me.

DR. NELSON BIAGGI: Mr. Chairman, Mr. Santiago, ladies and gentlemen: My name is Nelson Biaggi. I am representing the Directorship, Medical Sciences Campus, University of Puerto Rico; Dean of the School of Medicine of the University of Puerto Rico; Caribe Girl Scout Council; and the Sociedad Puertorriquena de Planificacion.

I promise to be real brief. I have only five points.

1. Many estuaries in Puerto Rico are heavily burdened by pollution, either of fecal or industrial origin or both. The cities of Arecibo, Isabels, Aguadilla, Mayaguez, Ponce, Guayama and Arroyo dispose of their raw or untreated sewage directly into the sea.

Metropolitan San Juan disposes of some 38 million gallons of primary effluent in the San Juan Bay. The pollutional effect in all cases of this indiscriminate disposal of raw or settled sewage is of a rather critical nature.

The San Juan Bay waters, for example, reveal a condition of eutrophication as observed from the photosynthetic activity and the benthal demand excerted by the bottom sludge. The aesthetic degradation of these waters goes without saying.

2. It seems urgent for the Aqueduct and Sewer Authority to:

(a) expedite toward secondary treatment for all the communities' sewage wastes that so demand.

(b) examine the financial implications of such enterprise and establish the methodology to effectively comply with it.

(c) stress optimal managerial operations of the existing sewage treatment plants to assure the best possible results.

(d) develop master plans for the collection, treatment and disposal of sewage for metropolitan areas, thus preventing excessive number of small installations that eventually lead to problems.

3. The great potential value for transportation purposes, aesthetical considerations, and others of the San Jose Lake, the Martin Pena Channel and the San Juan Bay justifies studies in depth on means and ways to recuperate these waters from pollution.

4. Many rivers in Puerto Rico suffer from periodic clogging of their disemboguement, thus preventing their discharges into the sea. As a result, of this anomalie, and due to the pollutional load of the rivers' waters, anaerobic decomposition does develop with the resulting foulness and anti-aesthetic conditions.

Also, mosquitoes do multiply in epidemic fashion. The Rio Grande of Arecibo and the Rio Yaguez of Mayaguez are good examples of this. The need exists to establish whose responsibility it is to cope with the problem and to see to it that the rivers maintain their flow in continuous discharge to the sea.

5. There are some sugar mills which dispose of their liquid wastes in mangrove swamps and these eventually flow into the sea. It must be recognized that the sugar mill wastes exert a very high BOD load and that these mills are among the most important sources of pollution in some of our estuaries.

Additional studies on mill wastes are required before any effective abatement program can be implemented. Thank you. (Applause)

MR. THOMAN: Thank you, Doctor. Are there any questions?

MR. TRAINA: No.

MR. THOMAN: Mr. Gustaro Candelas, University of Puerto Rico. Mr. Candelas, we didn't overlook you, but I had a note that you had already gone.

MR. GILBERTO CINTRON: I am not Mr. Candelas. I am Gilberto Cintron, a student at the University of Puerto Rico.

"The government of Puerto Rico has always assigned a considerable part of the budget for the purpose of education. Part of this budget is assigned to the University of Puerto Rico for its many needs.

"One of these needs is, of course, research. Since its establishment, the University has been crowded by an ever-increasing number of students and an always-increasing demand for teaching more and more diverse courses for more and more students.

"So it is not surprising that the amount of money assigned for research, especially in the sciences, has been really insignificant. Not only lack of funds, but the unusually heavy load in teaching which the University professor has to carry has reduced the time to embark on research programs.

"In spite of all these problems, the University's science departments have become more and more research-minded. This is so since it has become definitely clear that for the University to acquire the quality that all of us want, it must become more and more involved in research.

"Some funds derived from a planned economy in teaching have become available for research and the academic load for those interested in research has been reduced.

"This has been done through the creation of larger lecture sections and the elimination of some courses not essential for the preparation of our students.

"At present, all the science departments of the University of Puerto Rico at all of its campuses have graduate programs at least to the Master's level.

"Therefore, there is available the manpower necessary, not only in terms of professors, but also in terms of graduate students to carry out the research activities that are needed.

"Biological research has followed an ever-increasing trend. Unfortunately, due to its late beginning, it is behind the urgent needs of our community.

"Frequently, many government agencies are in need of information to develop policies or to solve immediate problems rooted in biological knowledge, and the information they need is unavailable.

"It was very unfortunate that our government has conceived the industrialization of the Island without a solid program for the development of local basic scientific research.

"It is essential for the government to realize this and assign special funds towards the creation of a program to foster basic research.

"One of the important trends of our times is the efficient exploitation of the sea and other water resources. Because of this and because they are integral parts of the adjacent shelf areas, the study of estuaries has become vital.

"As far as we know, no intensive biological research on this habitat has been done in Puerto Rico, and a search through the literature has shown that very little has been done in tropical estuaries.

"An unpublished work done at the Biology Department of Rio Piedras for the Planning Board has shown that our estuaries do contribute significantly to the adjacent marine environment.

"For example, the Torrecillas-Pinones Lagoon complex exports a net load of sediments toward the shelf in the order of 31 tons per day of sediments.

"These sediments are rich in organic matter. Also, this export represents a rich addition of dissolved nutrients to the shelf area.

"We have studied the movement of one of these vital nutrients in a preliminary way, and we have found that in the Laguna Grande in Fajardo, phosphorous is concentrated from three to seven times the value in the coastal area. Therefore, there may be a flux of water rich in phosphorous toward the shelf with the tide.

"In the same area, we have found that chlorophyll is concentrated almost four times its value in the shelf and slightly higher than in the adjoining bay.

"Although all rivers export dissolved and suspended matter towards the shelf, those estuaries and lagoons populated by mangroves seem to make the most valuable contributions.

"The rapid growth of these plants provides the estuary with a constant source of fallen leaves, twigs, branches and, of course, the large number of seeds that fall during the year.

"Of the total number of seeds that fall, only a small percentage germinates. All the others make a valuable addition of nutrients to the estuary.

"We cannot neglect the varied animal population that is associated with these areas. These, too, contribute by enriching the water with their wastes, and eventually, with their own carcasses.

"The mangrove swamp uses solar energy to maintain these communities, and it does it efficiently. Its chlorophyll content of .36 grams of chlorophyll a per square meter makes it comparable to other forests in the island.

"In a mangrove, there are from two to four square meters of leaves for each square meter of terrain. This makes possible an efficient utilization of the solar radiation.

"Associated with the mangroves in some estuaries and lagoons are Thallasia beds. Thallasia is a marine vascular plant. This provides another habitat and another source of food for the estuarine fauna.

"We have found in Fajardo that these beds may have a dry weight of 3.2 tons per acre, although higher values, from 3.7 to 4.9, are reported in the literature for the Bahia Fosforescente.

"Summarizing, our estuaries seem to make a valuable contribution to their adjacent shelf areas, and yet very little is known about their ecology or the ecology of the adjoining shelf.

"We must be cautious in applying to our estuaries criteria and concepts developed for nontropical estuaries, because there are fundamental differences in the ecosystems.

"Therefore, we need an intensive research program in the biology and ecology of our tropical estuaries and lagoons, if we are going to develop sound policies for the management of these areas."

Thank you.

MR. THOMAN: Thank you very much. Will you please express our regrets to Professor Candelas that we didn't get to him earlier?

Last among the speakers that I have a card on is my very good friend, Ramon Guzman.

MR. RAMON M. GUZMAN: There should be no doubt that Puerto Rico encounters serious water pollution control problems, at least in some of our surface streams and coastal waters.

Some of the problems are caused by the indiscriminatory discharge of industrial wastes and other waste waters. Although there are several reasons which adversely affect the proper maintenance of an adequate water pollution control abatement program in Puerto Rico, I will limit my short presentation at these public hearings to only one of the problems that we are facing in this respect -- the need of performance of basic and applied research for the treatment of industrial wastes and other waste waters which are discharged daily to our surface waters.

There are several industries which have been established in Puerto Rico since many years ago whose wastes have always been discharged to our streams without any treatment.

Year after year, these discharges have been the cause of massive fish kills, besides causing deterioration of our waters. In this group of industries we can mention the cane-sugar and rum manufacturing, among others.

There is no definite knowledge to dispose of these wastes adequately, mainly because of lack of basic research which will provide the needed information as to the economical methods for their degradation and final disposal.

Operation Bootstrap has attracted many industries to Puerto Rico. Its tax incentives will continue helping the establishment of new industries at a fast rate for the benefit of our economy.

But these industries will bring problems of waste treatment and water pollution for which we must be prepared. The environmental, climatological and economical conditions of Puerto Rico require, in many cases, different approaches for the proper treatment of the wastes.

We could gain much by the proper solutions to these problems through basic and applied research, or through demonstration projects. We must be fair and admit that not too much research in waste treatment and water pollution has been done in Puerto Rico.

It is now time to start the research to reduce the gap now existing in Puerto Rico between the technical knowledge needed and our realities in these problems of public health significance.

This information will help us to deal with the increasing amount of wastes being produced and discharged by the industries established here.

I would like, at this time, to call for the need of joining efforts to cope with the problem, with the participation of the Commonwealth and Federal governments and the private industry established in Puerto Rico.

The Department of Preventive Medicine and Public Health of the School of Medicine of the University of Puerto Rico is starting a program to develop basic and applied research in environmental health which will include some of the aspects of industrial waste treatment, sewage treatment and disposal, and water pollution control.

We know that the Department of Health of this Commonwealth and the Aqueduct and Sewer Authority have recognized the importance of research as applied to our specific problems and conditions.

The School of Medicine will gladly cooperate with technical assistance for the performance and promotion of research to deal with this type of problem on waste treatment and water pollution now being encountered by several Commonwealth government agencies and the private industry in Puerto Rico.

Let this be a call to join our efforts and obtain the needed technical information which is necessary to solve some of Puerto Rico's unique water pollution control problems.

Two months ago I was operating as Chief for the Aqueduct Authority, and in fact, the Secretary of the Water Pollution Control Advisory Board of the Commonwealth, and I had the pleasure at that time to work with the people of Atlanta, Mr. Thoman and Mr. Traina, and in my position -- well, I'm sure that I, again, have the same cooperation that I had when I was in my former position.

Speaking for Puerto Rico, I will say that we must be real happy to have people like Mr. Thoman, Mr. Traina and their staff in Atlanta for the interest they have shown in Puerto Rico.

I just wanted to add these words of thanks. Thank you very much.

MR. THOMAN: Thank you, Mr. Guzman.

MR. TRAINA: Ramon, I would like to ask you the same question I asked earlier. Do you have any idea of the order of magnitude of the amount of money that is required in research in this area of estuaries?

MR. GUZMAN: We at this time are making three proposals for research. One of the proposals will be for a sewage treatment plant, but the most important at this time that we are more interested in is in research to the criteria for sewage treatment plants.

I think this is one we really need. On this project, we have planned, we think it is about $70,000.

MR. THOMAN: Ramon, the question, I think, that Mr. Traina was asking, was strictly related to estuaries. Now, whether it's the disposal of treated effluents, ocean disposal, or this type of thing - if you would give some thought to that and drop us a letter, we will see that it becomes a part of the record.

I don't believe this design criteria project would be specifically applied to estuaries. The reason we have been asking these questions, as I explained to Dr. Cerame at noontime, is that we are trying to develop something in the report to the Congress that will give them some order of the magnitude as to what research efforts will be and are required.

This is the reason for the question. Dr. Cerame, do you wish to say something?

DR. CERAME VIVAS: For the record, this morning it was asked about how much it would cost, and I have here copies of two specific proposals that have been made by staff members in my department.

In one study is of Guayanilla Harbor, and the other one deals with the southwest coast of Puerto Rico. The total of one study for a two-year period came to $70,273, and for the other, it came to $84,000 for two years.

We have extrapolated that around Puerto Rico, thinking of all our shore lines, and mangrove and estuarine conditions, and it comes to 1.2 million dollars a year for a very thorough study of Puerto Rico.

MR. THOMAN: Thank you very much.

MR. TRAINA: Thank you.

MR. THOMAN: Is there anyone else that we have overlooked or who did not submit a card that would wish to make a statement at this particular time?

MR. GARCIA SANTIAGO: I would just like to thank all of you that have appeared here to give us your ideas and your recommendations and to speak on the problem of estuarine areas and pollution of the waters of Puerto Rico.

I believe that all of those people who have expressed their ideas have made a very necessary collaboration, not only for the benefit of Puerto Rico, but also to provide the necessary information for national estuarine interests.

I would like to thank each one of you. I would like to remind you that if any of you wish to add any other comments that might have been suggested in the course of the discussions here today, you may still do so within the next 15 days, and you may do so by writing in care of Mr. John R. Thoman, to his office in Atlanta, Georgia, at the address which you all have and which appears in the communique which he sent you, or you may send it through my office at the Planning Board, in which case, I would suggest that you would mark it "Personal", because otherwise, it would run the risk of not getting to my desk.

I would also like to thank all the friends from the Federal Water Pollution Control Administration office who have been here through the past few weeks, and especially today, and compliment you on the work and the preparation of this public hearing, which, by the way, has pleased me very much to hear such a variety of types of presentations made here today.

Finally, I would like to thank the Ba[illegible]ociation for letting us use these facilities. I especially want to thank my friends here from Puerto Rico who were participating in the organization of this activity, as well as the people from the press who have operated announcing this activity and who have been here today covering the presentations made here.

To all of you, on behalf of the government of Puerto Rico, thank you.

I know that Jack Thoman has to make a similar comment, so I would not like to take all the chances, so I will give him an opportunity to speak now.

MR. THOMAN: I was listening to the translation of Mr. Garcia Santiago's remarks, and I don't believe I have much to add, because I presume most of you understand Spanish.

Again, I want to extend my sincere thanks to all who have participated in this meeting. And I want to especially thank the Bar Association for making its lovely facilities available for us.

Again, I will remind you that the record is open for at least 15 days, and it will probably be closer to three weeks.

I want to thank all of you. I think out of the meeting today has come ideas which in the report to Congress will deserve special attention, because of the nature of Puerto Rico, in that it is an island and it has very unique problems both legal and otherwise.

I believe that these will have to be pointed out and taken care of in any legislation which may result from the National Estuarine Pollution Study.

Again, thanks to all of you for staying with us, and we appreciate your being here, and it has been a very deep and real pleasure. Thank you.

(Whereupon the meeting adjourned at 4:12 o'clock p.m.)

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ATTACHMENTS

Puerto Rico Farm Bureau ....
  Orstes Ramos - President

Cooperative Extension in Agriculture and
Domestic Economy Commonwealth of Puerto Rico ....
  Roberto Huyke - Extention Director

Municipal Government of Culebra ....
  Ramon Feliciano - Mayor of the Island of Culebra

Puerto Rican Yacht Club ....
  George A. Stuckert, Jr. - Commodore

Municipal Association ....
  Leo Cabranes - Executive Director

The Geological Society of Puerto Rico ....
  Pedro A. Gelabert - President

Commonwealth Oil Refining Company, Inc. ....
  Teodoro Moscoso - Chairman of the Board

Ponce Chamber of Commerce ....
  Manuel Aviles Toro - President

The Puerto Rico District Exchange Clubs ....
  Charles H. Reid - Chairman

University of Puerto Rico
School of Medicine ....
  Nelson Biaggi - Ph.D. Professor of Environmental Health

University of Puerto Rico at Mayagvez
College of Arts and Sciences
Department of Geology ....
  George A. Seiglie - Assistant Professor

Asociación de Agricultores de Puerto Rico
Condominio "San Martín"
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Señor Presidente:

Deseo agradecer la invitación que me ha hecho el señor John R. Thomas, Director Regional de la Administración Federal para el Control de la Contaminación del Agua, para que como Presidente de la Asociación de Agricultores de Puerto Rico (Puerto Rico Farm Bureau) presente en la mañana de hoy una ponencia sobre el uso optimo y el desarrollo futuro de áreas estuarias en Puerto Rico.

LOS ESTUARIOS EN PUERTO RICO

INTRODUCCION

Todos reconocemos la gran importancia de los estuarios que abundan en las zonas costaneras de los distintos continentes. En estos lugares las zonas estuarias constituyen una porción respetable de las costas. Alrededor del 80% de la costa del Atlántico Este y del Golfo está formada por estuarios, mientras que en la costa del Pacífico éstos constituyen solamente el 10%.

En Puerto Rico, por el contrario, la situación es distinta ya que por la configuración geométrica de nuestras costas, que tienden a ser más o menos rectas, y debido a que los ríos son de descarga relativamente pequeña, las zonas estuarias son minúsculas. Esto hace revelar nuestras dudas sobre la importancia de los estuarios como tal. Por otro lado no hay lugar a dudas que nuestras zonas costaneras, donde aunque en pequeña escala sigue prevaleciendo la inter-relación entre agua dulce y agua salada, sí son de vital importancia para el desarrollo socio-económico de esta Isla y para la vida puertorriqueña en general.

Por lo antes indicado nuestros comentarios se referirán no a áreas estuarias únicamente sino a nuestras zonas costaneras en general.

PROBLEMAS DE CONTAMINACION

Una consecuencia desafortunada del gran progreso que ha venido experimentando la Isla de Puerto Rico es la contaminación de sus cuerpos de agua con descargas de desperdicios, tanto domésticos como industriales. Todavía muchas poblaciones deshechan sus aguas negras sin tratamiento a los ríos y bahías. En algunas zonas de nuestra Isla ha habido que permitir cierto grado de contaminación por desperdicios industriales en aras de un mayor desarrollo económico mediante la creciente y necesaria industrialización. No hay duda de que hay entre los oficiales del gobierno y entre la ciudadanía una creciente preocupación por que nuestros recursos naturales, particularmente el agua, reciban mayor protección que lo que reciben en la actualidad si es que Puerto Rico ha de continuar disfrutando de su presente desarrollo económico.

Los problemas asociados a la descarga de desperdicios en los cuerpos de agua son la reducción del contenido de oxígeno disuelto en el agua con la consecuente muerte de los peces por asfixia, la mortalidad de los peces por sustancias tóxicas, la producción de malos olores, la creación de condiciones ofensivas al sentido de la vista y al olfato, la contaminación del agua por organismos productores de enfermedades y la destrucción de diversas formas de vida acuática. Estos problemas son comunes tanto a las aguas dulces como a las saladas.

Estas aguas así deterioradas en su calidad requieren tratamientos más elaborados y costosos cuando se necesita su utilización para uso municipal o industrial. Los cuerpos de agua que han sido contaminados por sustancias nocivas a la salud, dejan de estar disponibles para uso recreativo, destruyéndose así uno de los valores con que deberíamos poder contar en todo momento que es el turismo y también la recreación del ciudadano local.

Como ya hemos indicado anteriormente existen en Puerto Rico un gran número de pueblos que descargan sus aguas negras sin tratamiento alguno a las aguas costaneras cercanas a ellos. Hay además algunos ríos que reciben las aguas negras de las poblaciones a su orilla y éstos a su vez descargan al mar. Ejemplo de la primera de un mayor desarrollo económico mediante la creciente y necesaria industrialización. No hay duda de que hay entre los oficiales del gobierno y entre la ciudadanía una creciente preocupación por que nuestros recursos naturales, particularmente el agua, reciban mayor protección que lo que reciben en la actualidad si es que Puerto Rico ha de continuar disfrutando de su presente desarrollo económico.

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El problema de los ríos en sí se torna más severo durante las épocas de sequía que, añadido a la hidrología particular de Puerto Rico, crean una situación de flujo sumamente pequeño que no ofrecen oportunidad para la dilusión de los contaminantes. Estos ríos terminan por convertirse en meras cloacas sanitarias. El Río Yaguez en el Oeste de la Isla es un triste ejemplo de esta situación.

RECOMENDACIONES PARA EL CONTROL DE LA CONTAMINACION POR AGUAS NEGRAS MUNICIPALES

1. Para controlar la contaminación de ríos, lagos y lagunas es indispensable que se provean plantas de tratamiento completo (incluyendo la desinfección de los efluentes) para todas las aguas negras que descarguen a estos cuerpos de agua, así como la modificación de las plantas existentes donde sea necesario. Es menester alcarar que, aunque reconocemos que los cuerpos de agua tienen una cierta capacidad de auto depuración, asunto éste que está bajo investigación en el Instituto de Agua de la Universidad de Puerto Rico, no podemos permitir la utilización a cabalidad de este fenómeno por cuanto nuestros cuerpos de agua son pequeños y la concentración poblacional e industrial va cada día en aumento y con ello la contaminación.

2. Para el control de la contaminación de las aguas costaneras se recomienda igualmente el tratamiento adecuado de las aguas negras antes de lanzarlas al mar. Es indispensable que este tratamiento sea seguido de una desinfección efectiva, si es que queremos conservar nuestras playas en el estado de saneamiento necesario para su aprovechamiento como medio recreativo. Se debe tomar muy en cuenta el diseño adecuado de los sistemas hidráulicos de emisión de los efluentes al mar, tomando en consideración las técnicas más modernas que están en desarrollo en la actualidad, de modo de lograr

una dispersión efectiva de estos efluentes en el mar sin riesgos de contaminación. Esto requiere estudios hidraúlicos e hidrográficos de nuestras costas para determinar corrientes, temperaturas, densidades del agua, etc.

3. Deben tomarse medidas para aumentar los flujos bajos en los ríos durante las sequías. Esto puede lograrse mediante el almacenaje en embalses de parte del agua durante las épocas de lluvia, la cual puede luego soltarse en forma controlada durante las sequías para mantener un flujo adecuado en todo momento. Estos embalses servirían además para proveer abastos de agua y para elevar el nivel freático aumentándose así el caudal de las aguas subterráneas. Estas pueden ser muy útiles en la solución de los problemas de abastecimiento de agua. Esto se ha hecho en Puerto Rico en cierta forma limitada pero no hay duda que esto debe expandirse.

4. Es menester mantener las bocas de los ríos abiertas para evitar el estancamiento de sus aguas con los resultantes problemas sanitarios que por esta causa se producen. El cierre de las bocas se puede evitar mediante la construcción de "jetties" adecuadamente diseñados o se puede controlar mediante la remoción periódica de los sedimentos que se depositan en las mismas.

RECOMENDACION PARA EL CONTROL DE LA CONTAMINACION POR DESPERDICIOS DE CENTRALES AZUCARERAS

En los últimos años nos ha causado preocupación la naturaleza de la contaminación originada por las descargas de las centrales azucareras. Esta preocupación es aún mayor cuando reconocemos las limitaciones económicas en que se está desenvolviendo esta industria, lo cual hace difícil imponerle reglamentaciones que requieran el uso de equipo de purificación a estas centrales que pueden ser en muchos casos lo suficientemente costosos como para agravar la situación económica de las mismas. Posiblemente, el gobierno en estos casos tendría que asumir cierta responsabilidad con respecto a los costos de la purificación o disposición de los desperdicios de estas centrales.

RECOMENDACIONES PARA EL CONTROL DE LA CONTAMINACION POR DESPERDICIOS INDUSTRIALES (OTRAS INDUSTRIAS)

1) Se recomienda que se hagan los estudios pertinentes sobre la posible contaminación de las aguas por los desperdicios de las industrias que operan en Puerto Rico. Esto serviría de base para reglamentar la disposición de estos desperdicios tanto de las industrias ya establecidas, como de las que puedan establecerse en el futuro.

2) A aquellas industrias que estén localizadas en zonas donde se ponga en peligro la subsistencia de valiosos recursos de agua, tales como áreas recreativas y criaderos de especies marinas, se recomienda que se les exija tratamiento adecuado a sus desperdicios de modo de que se conserve el estado natural del cuerpo de agua.

3) En las zonas industriales se debe considerar la posibilidad de utilizar facilidades de tratamiento comunes a todas las industrias del conglomerado industrial. Esto ayudaría a prorratear el costo del tratamiento de los desperdicios, haciéndolo así más económico. Con esto se mejoraría la actitud de la industria hacia los reglamentos de control de contaminación.

4) Deben de zonificarse nuestras áreas costaneras de tal forma que se establezcan zonas industriales que estén alejadas de las áreas recreativas y de aquellas bahías que tienen gran atractivo estético. Hasta el presente se ha llevado la industria a lugares cercanos al ambiente urbano donde habita el obrero. Socialmente esto parece adecuado ya que se pretende mejorar el nivel de vida del obrero puertorriqueño. Sin embargo, en lo que a la industria pesada se refiere, los riesgos de

generalizar la contaminación mediante la diseminación de este tipo de industria por toda la Isla son realmente alarmantes. Debemos empezar a pensar en términos de, por el contrario, mover el obrero de todas partes de la Isla a la zona industrial mediante medios adecuados de transportación en masa. Esto creemos que es muy factible ya que se hace en otras partes del mundo donde las distancias son mucho mayores. La concentración de la industria pesada en un lugar tiene las ventajas adicionales de lograrse mayor economía en proveer las facilidades de acceso, agua, tratamiento común de los desperdicios, etc.

5) Deben alejarse las industrias de areas que tengan suma importancia desde el punto de vista biológico y marino.

6) Debe planearse la localización de estas zonas industriales tomando en consideración las corrientes marinas de modo que cualquier contaminante que por alguna razón llegue a las aguas afecte lo menos posible las areas que se deben proteger.

7) Debe exigirse tratamiento completo a los desperdicios industriales teniendo en cuenta que siempre existe la posibilidad de la reclamación de sustancias útiles durante el proceso de tratamiento. Es muy importante que se provea duplicación del equipo esencial ya que en ningún momento una falla en equipo debe de constituirse en riesgo de contaminación.

PECTICIDAS, YERBICIDAS, ETC.

Los pecticidas que se le aplican al suelo o a las plantas generan hoy día problemas de contaminación que nos causa seria preocupación. Mientras la cantidad de pecticidas usándose aumenta vertiginosamente, también reconocemos la gran capacidad que tienen las plantas para concentrar estas substancias.

La magnitud de la contaminación de las aguas costaneras debido a los pecticides es hasta cierta punto desconocida y quizás el paso más apropiado a tomarse es hacer un estudio exhaustivo para determinar la seriedad del problema.

ACCION DEL HOMBRE

No podemos olvidar el peligro que resulta para nuestros limitados estuarios y para nuestras aguas costaneras la acción destructiva del hombre en sus planes de expansión y en sus programas de reclamación de tierra donde por un lado destruye manglares que pueden ser atrayentes areas recreativas y ambiente favorable para el desarrollo de la fauna y la flora marina, sino que también contamina su ambiente con la disposición de basuras y descarga sanitaria de las viviendas que se han ido construyendo en los litorales costaneros.

Las autoridades competentes deben además asumir una actitud más estricta contra el creciente uso de nuestros ríos y estuarios como lugar para el deshecho de basuras. Estas no sólo empeoran el problema sanitario sino que también reducen considerablemente el cauce de la corriente acentuando el problema de inundaciones que existe en muchos pueblos.

Puerto Rico Farm Bureau

Condominium of "San Martin"

23 Parada - Santurce, Puerto Rico

Telephone
722-2981 & 724-6867

P. O. Box 8114
Santurce, P.R. 00910

Founded in 1924

Affiliate of the American Farm Bureau Federation

Mr. President:

I wish to thank you for the invitation extended me by Mr. John R. Thoman, Regional Director of the Federal Administration for Water Pollution Control, that I, as President of the Puerto Rico Farm Bureau, may present a report this morning on the optimum usage and future development of Puerto Rican estuarine areas.

Puerto Rico Farm Bureau
Condominium of "San Martin"
23 Parada - Santurce, Puerto Rico
Founded in 1924
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ESTUARIES IN PUERTO RICO

INTRODUCTION

We all recognize the great importance of the estuaries which abound in the coastal areas of the several continents. In those places, the estuarine zones constitute a considerable portion of the coasts. Approximately 80% of the East Atlantic Ocean and the Gulf of Mexico is formed by estuaries, while they constitute only 10% of the Pacific Coast.

On the contrary, the situation in Puerto Rico is different, since the estuarine zones are quite small on account of the geometric configuration of our coasts which tend to be more or less straight, and on account of the relatively small discharge of the rivers. This raised doubts as to the importance as such. On the other hand, there can be no doubt that, where the interrelationship of fresh and salt water continues to prevail even if on a small scale, coastal areas are of such vital importance to the socio-economic development of this island and to Puerto Rican life in general.

As previously indicated, our comments refer not only to estuarine areas but also to our coastal areas in general.

PROBLEMS OF POLLUTION

An unfortunate consequence of the great progress experienced by the Island of Puerto Rico is the pollution of its bodies of water by the emptying of waste products, domestic as well as industrial. Still many towns release their untreated polluted waters into the rivers and bays. In some areas, a certain amount of pollution by industrial wastes has been permitted in favor of greater economic development via the growing and necessary industrialization. There is no doubt that there is an increasing concern among government officials and the citizenry. If Puerto Rico is to continue to enjoy its present rate of economic growth, our natural resources, particularly water, must receive greater protection than that which it now has.

The problems associated with the dischargal of waste products into bodies of water, are: the reduction of the oxygen content of the water with a resultant death of fish by suffocation, fish's being killed by toxic substances, the creation of conditions offensive to sight and smell, the pollution by disease-producing organisms and the destruction of diverse forms of aquatic life. These problems are common to both fresh and salt water.

Waters so reduced in quality require more elaborate and expensive treatments when they are needed for municipal or industrial purposes. Bodies of water polluted by substances harmful to health, have ceased to be available for recreational use. One of the values on which we ought to be able to depend at all times, tourism and the recreation of the local citizen, has thus been destroyed.

As we have previously stated, a great number of towns which empty untreated polluted water into nearby coastal waters, does exist. In addition, there are some rivers which receive the contaminated waters from the towns on their shores. These rivers, in their turn, empty into the sea. An example of the first instance is Mayaguez. San German, emptying its waters into the Guansjibo River which finally empties into the Bay of Mayaguez, is an example of the second situation.

The problem of the rivers themselves becomes more severe in the time of drought. That, added to the hydrology particular to Puerto Rico, creates a situation of the flow being so very slight that it offers no opportunity for the dissolution of contaminants. These rivers end up becoming mere sewers. The Yaguez River in the east section of the island is a sad example of this situation.

RECOMMENDATIONS FOR CONTROL OF POLLUTION BY FOULED MUNICIPAL WATERS

1. In order to control pollution of rivers, lakes, and lagoons, the provision of complete treatment plants (including the disinfection of effluences) is indispensable for all polluted water which empty into these water bodies. The modification of existing plants is also necessary. It should be made clear that, though recognizing that bodies of water have a certain capacity for self-purification (a subject under the investigation of the Water Institute of the University of Puerto Rico), we cannot permit the fullest utilization of this phenomenon, in as much as our bodies of water are small. And the industrial and population concentration grows daily, and with it, pollution.

2. In order to control pollution of coastal waters, the adequate treatment of polluted water is recommended before the water is emptied into the sea. It is absolutely necessary that this treatment be followed by effective disinfection, since we wish to preserve our beaches in a state of cleanliness necessary to their use as a recreational medium. One should be acutely aware that the adequate design of hydraulic systems for the emission of the effluences into the sea must be considered. Also to be considered are the most modern techniques which are presently in development, to achieve an effective dispersion of those effluences into the sea without risk of pollution. This requires hydraulic and hydrographic studies of our coasts to determine currents, temperature, water densities, etc.

3. Measures should be taken to increase the low level of flow of the rivers during a drought. This can be achieved by means of storage of part of the water in dams during rainy periods. The stored water could then be released in a controlled way during the droughts in order to maintain an adequate flow at all times. These dams would also be used to provide water supplies and to raise the phreatic level, thus increasing the volume of subterranean water. That could be very useful in the solution of the problems of water provisioning. This has been done to a limited degree, but doubtlessly could be extended.

4. It is necessary to keep river mouths open to avoid stagnation and the resultant sanitation problems. The closing of the river mouths may be avoided by constructing jetties adequately designed. It may also be controlled through the periodic removal of deposited sedimentation.

RECOMMENDATION FOR THE CONTROL OF POLLUTION BY COMMUNITY SUGAR MILL WASTES

In the last few years, the nature of pollution caused by the discharge of the community sugar mills has caused us concern. This concern increases when we recognize the economic limitations under which this industry is developing. This condition makes it difficult to impose regulations upon the sugar industry, requiring the use of purification equipment for these community mills which, in many cases, can be sufficiently expensive as to aggravate their economic situation.

RECOMMENDATION FOR CONTROL OF POLLUTION FROM INDUSTRIAL WASTE PRODUCTS (OTHER INDUSTRIES)

1. It is recommended that studies pertinent to the possible pollution of water by waste products of the industries which operate in Puerto Rico, be made. This would serve as a basis for regulating the deposition of these waste products, for already established industries, as well as those which may be established in the future.

2. It is recommended that adequate treatment of their waste products be demanded of those industries which are located in areas where valuable water resources are placed in jeopardy, in order to conserve the natural state of the body of water.

3. The possibility of using treatment facilities common to all the industries of the industrial group ought to be considered in those industrialized areas. This action should help prorate the cost of waste treatment, thus rendering it more economical. With this step, the attitude of industry toward the regulation of pollution control should be improved.

4. Our coastal areas should be zoned in such a way as to establish industrial areas which are removed from the recreational areas and from those bays which have great aesthetic attraction. Up until the present, industry has brought an urban atmosphere to the nearby towns where workers live. Socially, this seems fitting since it attempts to improve the standard of living of the Puerto Rican worker. Nevertheless, touching upon heavy industry, the risks of spreading pollution (by means of the spread of this kind of industry) are really alarming for the entire island. We should begin to think in terms of moving the worker to the industrial zones from all parts of the island via adequate mass transportation. We believe this to be quite feasible, since it is done in other parts of the world where distances are greater. Concentration of heavy industry in one place has the added advantages of achieving greater economy in providing the facilities for access water, and common waste treatment.

5. Industries should withdraw from areas which have great importance from the biological and marine point of view.

6. Localization of these industries should be planned, taking into account the sea currents so that whatever pollutant, which for any reason, reaches the water, has the least possible effect on the areas which should be protected.

7. Complete treatment of industrial waste products should be required, taking into account that the possibility of reclamation of useful substances always exists during the treatment process. It is very important that duplication of essential equipment be provided so that at no time would an equipment failure constitute a risk of pollution.

PESTICIDES, HERBICIDES, ETC.

The pesticides applied to the soil or to plants today generate problems of pollution which cause us serious concern. While the quantity of pesticides being used grows dizzingly, we also recognize the great capacity which plants have to concentrate these substances.

The magnitude of pollution of coastal waters due to pesticides, is to a certain degree unknown and perhaps, the most appropriate step to make an exhaustive study to determine the seriousness of the problem.

MAN'S ROLE

We cannot forget the danger which results from the destructive action of man in his plans of expansion and his programs of land reclamation, threatening our limited estuaries and our coastal waters. Land reclamation, on one hand, destroys mangrove swamps, which can be attractive recreation areas, and a favorable environment for the growth of marine flora and fauna. Land reclamation cannot be accomplished without also contaminating the environment with the deposition of rubbish and the emptying of sanitation wastes from the dwellings which have continued to be constructed in the coastal areas.

Competent authorities, moreover, should assume a stricter attitude toward the increasing use of our rivers and estuaries as a place for the dumping of rubbish. These things not only worsen the sanitation problem, but it also reduces considerably the current's channel, accentuating the problem of flooding in many towns.

TRABAJO COOPERATIVO DE EXTENSION
EN
AGRICULTURA Y ECONOMIA DOMESTICA
ESTADO LIBRE ASOCIADO DE PUERTO RICO

RECINTO UNIVERSITARIO DE MAYAGUEZ
DE LA
UNIVERSIDAD DE PUERTO RICO
EN COOPERACION CON EL
DEPARTAMENTO DE AGRICULTURA
DE
ESTADOS UNIDOS DE AMERICA

SERVICIO DE EXTENSION
Rio Piedras, Puerto Rico 00928

15 de abril de 1968

Sr. John R. Thoman, Director
Southeast Region
Federal Water Pollution Control Administration
Department of Interior
1421 Peach Street NE
Atlanta, Georgia 30309

Estimado señor Thoman:

Me complazco en acusar recibo de su comunicación del 2 de abril de 1968, relacionada con la audiencia pública a celebrarse en San Juan el 22 del corriente mes en la cual se discutirán los puntos de vista sobre el uso óptimo y desarrollo futuro de los recursos estuarios.

Nuestra exposición en relación al tema antes mencionado no creemos que proceda a presentarla en forma de ponencia. Queremos, sin embargo, anotar nuestra posición y cooperación en cuanto al problema de la contaminación de los estuarios en Puerto Rico.

En Puerto Rico, así como en los Estados Unidos, los estuarios desempeñan una función de gran importancia como fuente de abasto de agua para la industria, además de servir como base para las operaciones portuarias, factor importante en el desarrollo económico del país, así como para la recreación, la pesca y otros fines.

La contaminación y la pobre administración de estos estuarios han afectado en gran medida el uso beneficioso de los mismos.

Es de imperiosa necesidad que el estudio que usted indica en su carta, relacionado con los problemas de contaminación de los estuarios, se realice y se presente al Congreso de los Estados Unidos para su más pronta consideración, de manera que pueda surgir un programa efectivo para la conservación de los recursos y bellezas naturales del país.

En Puerto Rico la Honorable Cámara de Representantes designó una comisión especial de ese cuerpo, presidida por el Hon. Manuel Méndez Ballester, para que investigara la conservación y control de los recursos y bellezas naturales de la Isla, en los cuales están incluidos los estuarios y aguas costaneras.

El Hon. Manuel Méndez Ballester solicitó la cooperación del Presidente de la Universidad de Puerto Rico, Lcdo. Jaime Benítez, para ayudar a la comisión legislativa en las gestiones que le fueran encomendadas.

El Presidente nombró grupos de trabajos formados por técnicos de todos los recintos universitarios, incluyendo sus dependencias agrícolas. Además, reclutó la cooperación de técnicos de otras agencias de gobierno y universidades privadas para esa gestión de gobierno.

Los informes de los distintos grupos de trabajo se agruparon en un documento titulado "Informe de la Universidad de Puerto Rico a la Honorable Comisión Especial de la Cámara de Representantes para Investigar la Conservación de Recursos y Bellezas Naturales."

En ese informe se destacan cuatro recomendaciones principales, a saber:

1. Que se cree un organismo gubernamental con rango de gabinete para implementar la política pública sobre la conservación de los recursos y bellezas naturales que dicte la Comisión de Recursos nombrada por el Gobernador con la aprobación de la Asamblea Legislativa.

2. Que se enmiende la ley de la Junta de Planificación para hacer viable la zonificación en la zona rural.

3. Que se realice un inventario a la mayor brevedad posible de todos los recursos naturales de excepcional belleza y valor científico para que el Gobierno adquiera y conserve estos recursos a perpetuidad.

4. Que en todos los niveles educativos se fortalezca la enseñanza sobre el uso y conservación de los recursos naturales y se adiestren técnicos de alto nivel para los programas a desarrollarse.

De las recomendaciones incluidas en el informe de los diferentes grupos, citamos las que conciernen o están relacionadas en cierta medida con los estuarios y aguas costaneras:

1. Controlar la contaminación de las aguas costaneras perjudicial a la vida marina y desarrollar métodos que faciliten la disposición de los productos nocivos sin causar este problema.

2. Preservar como parques varias áreas de mangles y la bahía luminiscente, asegurando que se evite su destrucción y

preservando su utilidad como criadero de especies marinas de valor económico.

3. Proveer para el control de la captura y venta de los organismos asociados con los arrecifes.

4. Determinar en qué lugares y hasta qué grado debe permitirse la extracción de arena de las playas, reglamentar mientras tanto toda extracción de arena y reconstruir las playas que han sido destrozadas por la extracción de arena.

5. Revisar las leyes sobre los recursos de agua vigentes en Puerto Rico e incluir en ellas el control de la explotación de las reservas de agua bajo tierra.

6. Planificar y coordinar el desarrollo y el uso de los recursos de agua a largo plazo.

7. Expandir los estudios básicos sobre los recursos de agua de Puerto Rico y los métodos para lograr su mayor aprovechamiento por mediación del Instituto de Investigaciones sobre Recursos de Agua.

8. Desarrollar métodos y efectuar el control de la contaminación de los ríos, lagos y lagunas por aguas negras y desperdicios industriales.

9. Determinar la posibilidad de usar las estructuras y canales para controlar las inundaciones en las cuencas que aún no han sido estudiadas.

El Servicio de Extensión Agrícola del Recinto Universitario de Mayaguez, como la rama educativa del Departamento de Agricultura de los Estados Unidos, respalda las recomendaciones hechas en el informe sometido a la Honorable Cámara de Representantes.

En esta gestión que requiere el informe, creemos firmemente que para poder realizar una labor efectiva se deben proveer fondos específicamente para cada agencia para reclutar y preparar personal especializado en las diferentes fases de la conservación de los recursos naturales.

No obstante, queremos hacer claro que ofrecemos todas nuestras facilidades, tanto físicas como de personal, para cualquier gestión en que nuestra agencia pueda ser útil en la solución de los problemas de los estuarios y aguas costaneras de Puerto Rico, así como en la conservación de los recursos y bellezas naturales de nuestro país.

Cordialmente,

Roberto Huyke

Roberto Huyke
Director de Extensión

RH:ec

Cooperative Extension
in
Agriculture and Domestic Economy
Commonwealth of Puerto Rico

University of Puerto Rico
at Mayaguez
In Cooperation with the
Department of Agriculture
of the
United States of America

Extension Service
Rio Piedras, Puerto Rico 00928

April 15, 1968

Mr. John R. Thoman, Director
Southeast Region
Federal Water Pollution Control Administration
Department of the Interior
1421 Peachtree Street NE
Atlanta, Georgia 30309

Dear Mr. Thoman:

I am pleased to acknowledge your letter of April 2, 1968 concerning the public hearing to take place in San Juan the twenty-second of this month, in which the views dealing with the optimum use and future development of estuarine resources will be discussed.

We feel that our position on this subject cannot be properly presented in a report. Nevertheless, we wish to state our position and offer our cooperation concerning the problem of pollution of the Puerto Rican estuaries.

In Puerto Rico, as in the rest of the world, the estuaries have a highly important function as a source of water for industry. They also serve as a base for port operations, which is an important factor in the country's economic development, and they are important for recreation, fishing and other purposes.

Pollution and poor administration of these estuaries have greatly effected the beneficial uses of the estuaries.

It is of the utmost necessity that the study cited in your letter, concerning the problems of estuarine pollution, be undertaken and be presented to the Congress of the United States for it's most immediate consideration so an effective program for the conservation of the country's resources and natural beauties.

In Puerto Rico, the House of Representatives names a special committee, headed by the Honorable Manuel Mendez Ballester, to investigate the conservation and control of the island's resources and natural beauties Estuaries and coastal waters are included.

The Honorable Manuel Mendez Ballester sought the cooperation of the President of the University of Puerto Rico, Jaime Benitez, Lcdo., in aiding the legislative committee in the measures intrusted to them.

The President appointed work groups made up of technicians from all the university extensions, including their agricultural agencies. He also enlisted the cooperation of the technicians of other government agencies and of private universities in this step.

The reports of the different work groups are combined in a document entitled "Report of the University of Puerto Rico to the Honorable Special Commission of the House of Representatives, for the Investigation of Conservation of Resources and Natural Beauties".

Four principal recommendations stand out in this report:

1. That a governmental organization of cabinet level be created to implement public policies about the conservation of resources and natural beauties. This organization shall be designated by the Commission on resources, and appointed by the Governor with the Legislative Assembly.

2. That the Law of the Planning Council be ammended to make zonification feasible in rural areas.

3. That an inventory of all the natural resources of exceptional beauty and scientific worth, be taken as soon as possible, so that the Government may acquire and conserve these resources forever.

4. That instruction about the use and conservation of natural resources be strengthened at all educational levels and that high level technicians be trained to develop the programs.

Of the recommendations included in the report, we point out those which, in some way, concern or are realted to the estuaries and coastal waters:

1. To control coastal water pollution injurious to marine life and to develop methods to facilitate the disposal of noxious waste products without causing pollution.

2. To preserve mangrove areas and the shining bay as parks, assuring that it's destruction will be circumvented, and also preserving it's usefulness as a breeding area for marine species of economic value.

3. To provide for the control of the hunting and sale of organisms associated with the coral reefs.

4. To determine which locations and to what degree the removal of sand from the beaches shall be permitted. And to regulate, in the mean time, the removal of sand and to reconstruct the beaches which have been destroyed by removal of sand.

5. To revise the laws in force concerning water resources in Puerto Rico and to include in those laws, the control of exploitation of subterranean water reserves.

6. To plan and to coordinate the development and use of water resources on a large scale.

7. To expand basic studies of Puerto Rican water resources and studies of the methods of achieving its greatest use through the mediation of the Institute of Research of Water Resources.

8. To develop methods for and to effect the control of, pollution of rivers, lakes and lagoons by contaminated waters and industrial waste products.

9. To determine the possibility of using structures and canals to control flooding of watersheds, not yet studied.

The Agricultural Extension Service of the University of Puerto Rico at Mayaguez, as the educational branch of the U.S. Department of Agriculture, endorses the recommendations made in the report submitted to the House of Representatives.

In this step which the report requires, we firmly believe that, in order to realize an effective effort, funds should be specifically provided for each agency for the recruitment and preparation of specialized personnel in the different phases of conservation of natural resources.

Nevertheless, we wish to make it clear that we offer all our facilities, both physical and human, for whatever measure in which our agency may be of use in the solution of the problems of Puerto Rican estuaries and coastal waters, as well as in the conservation of resources and natural beauties in our land.

Cordially yours,

Roberto Huyke
Extension Director

ESTADO LIBRE ASOCIADO DE PUERTO RICO
GOBIERNO MUNICIPAL DE CULEBRA
OFICINA DEL ALCALDE
CULEBRA, PUERTO RICO

8 de abril de 1968

Señor John R. Thoman, Director Regional
Federal Water Pollution Control Administration
Departamento del Interior de Estados Unidos
San Juan, Puerto Rico

Estimado señor Thoman:

La presente comunicación es relacionada con las aguas costaneras alrededor de la Isla de Culebra y sus islotes adyacentes incluyendo también algunos lagos y lagunas.

El primer problema confrontado por nuestros habitantes es cuando desean visitar las playas de la costa norte y este de la isla y se encuentran con la gran cantidad de botellas, cajas de madera, petróleo y otras desperdicios que flotan. Esto ha ocurrido desde que se estableció el nuevo sistema de botar la basura en la isla de Saint Thomas que según pude presenciar es lanzada al mar frente a la costa este de Culebra y luego arrastradas con las mareas hasta nuestras playas.

Las playas mas afectadas son las siguientes: Playa Larga, Zoní, Las Vacas, y Manzanillo. En estas playas fueron suspendidas las actividades de baños y veraneo por las muchas botellas rotas que causaban heridas a las personas, igual que las maderas con clavos son amenzas a los bañistas que utilizan dichas playas.

Otro problema de water pollution, es las aguas alrededor de la población de Dewey por la falta de alcantarillado; la población ha estado usando por toda la vida el sistema de letrinas para servicio de sanidad con descargas que conducen directamente al mar por todos los alrededores, contaminando el agua salada y evitando la crianza de peces y ocacionando malos olores en la comunidad, además el deterioro de la fase pintoresca de nuestro pueblo.

Esta situación de aspecto sanitario fué sometida al Gobernador de Puerto Rico para que se tomara acción, pero no se ha tomado acción ninguna. El procedimiento del uso de letrinas con descargas al mar, sigue siendo aumentado y la contaminación será mayor cada año si no se toma acción pertinente.

Sin otro particular, quedo de usted

Atentamente,

Ramón Feliciano
Alcalde Isla de Culebra

Commonwealth of Puerto Rico
Municipal Government of Culebra
Office of the Mayor
Culebra, Puerto Rico

April 8, 1968

Mr. John R. Thoman, Regional Director
Federal Water Pollution Control Administration
Department of the Interior of the United States
San Juan, Puerto Rico

Dear Mr. Thoman:

This letter concerns the coastal waters around the Isla of Culebra and the adjacent inlets, and it includes some lakes and lagoons, too.

The first problem faced by our citizens is that, when they wish to go to the beaches on the north and east coasts of the island, they find a great quantity of bottles, wooden boxes, oil and other floating debris. This has happened since the new system of dumping trash on the Island of St. Thomas was established. As well as I can figure it out, the trash is thrown into the sea opposite the east coast of Culebra and is then carried toward our coasts by the tides.

The beaches most affected are the following: Playa Larga, Zeni, Las Vacas and Manzanilla. The activities of swimming and of vacationing were suspended at these beaches becuase of the many broken bottles which caused injury to people; boards with nails are menaces to the swimmers who use the beaches.

Because of the lack of sewage systems, the waters around the town of Dewey are another pollution problem. For sanitation services, the town has been using a system of latrines for its lifetime. The labrines have outlets which lead directly to the sea on all sides, thus contaminating the brackish waters, inhibiting fish breeding, and causing bad smells in the community. This condition has also caused the deterioration of the town's picturesque quality.

The situation and its sanitary aspect were submitted the Governor of Puerto Rico so he might take action, but he has done nothing at all. The practice of using latrines with outlets into the sea, continues to to spread and increase, and the pollution will be greater each year if no pertinent action is taken.

With no other subject to discuss, I remain

Cordially yours,

Ramon Feliciano
Mayor of the Island of Culebra

Federación Náutica de Puerto Rico

APARTADO G.P.O BOX 3521, SAN JUAN, P. R. 00936

Afiliados a:

COMITE OLIMPICO
DE PUERTO RICO

INTERNATIONAL YACHT
RACING UNION

NORTH AMERICAN YACHT
RACING UNION

18 de abril de 1968

Director
South East Region
Suite 300
1421 Peachtree Street
Atlanta, Georgia 30309

Estimados señores:

Me refiero a vuestra carta fechada 1 de abril de 1968, ofrezco los siguientes comentarios sobre el uso y la contaminación de las aguas estuarias de Puerto Rico.

El gobierno de la Capital pidió a la Sailfish - Sunfish Association que celebrara una regatta en la laguna del Condado como parte de las Fiestas Patronales a fines de Junio.

Debido a la contaminación de la laguna, esta regatta será cambiada a otro lugar. Excepto por la contaminación, la laguna es el sitio ideal.

San Juan está en una situación única, en cuanto a recursos acuáticos. Las lagunas de San José, Torrecillas, Condado, y de Piñones podrían ser dragadas a pequeña profundidad y reservados para deportes acuáticos. Uno para botes de motor, uno para botes de vela, y otro para el uso exclusivo de esquiadores, etc.

El desarrolo de nuestras lagunas para estos usos tendría un impacto fuerte y saludable en la economía de Puerto Rico, y de San Juan en particular.

1. Sería una gran atracción turística.
2. Atraería a Puerto Rico atracciones acuáticas de fama mundial.
3. Atraería a la juventud de Puerto Rico a los deportes como participantes en vez de expectadores.

No estoy capacitado para comentar acerca de las causas de la contaminación o como resolver los problemas envueltos. Tampoco tengo conocimientos de los aspectos médicos, los cuales tengo entendido son serios.

Le doy las más expresivas gracias por la oportunidad de presentar mis puntos de vista.

Atentamente,

GEORGE A. STUCKERT, JR.
Comodoro
Federación Náutica de P. R.

rmp

Puerto Rican Yacht Club
G.P.O. Box 3521, San Juan, P.R., 00936

Affiliates of
Puerto Rican Olympic Committee
International Yacht Racing Union
North American Yacht Racing Union

April 18, 1968

Director
Southeast Region
Suite 300
1421 Peachtree Street
Atlanta, Georgia 30309

Dear Sirs:

In reference to your letter of April 1, 1968, I offer the following comments about the use and pollution of Puerto Rican estuarine waters.

The government at the capitol asked the Sailfish-Sunfish Association to hold a regatta in the Condade Lagoon as part of the Patron Saint's Day celebration at the end of June.

San Juan is in a unique position as to aquatic resources. The lagoons of San Jose, Torrecillas, Condado and Piñones could be dredged at a shallow depth and set aside for aquatic sports. One for motor boats, one for sail boats and another for the exclusive use of skiers, etc.

The development of our lagoons for these uses would have a strong and salutory impact on the Puerto Rican economy, and on that of San Juan in particular.

1. It would be a great tourist attraction.
2. It would bring aquatic sports attractions of world renown to Puerto Rico.
3. It would bring sports to the youth of Puerto Rico so they might be participants instead of spectators.

I am not able to comment on the causes of pollution, or of how to resolve the problems involved.

I give you my most sincere thanks for the opportunity of presenting my views.

Cordially yours,

George A. Stuckert, Jr., Commodore
Puerto Rican Yacht Club

ESTADO LIBRE ASOCIADO DE PUERTO RICO
ASOCIACION DE ALCALDES
1810 AVE. PONCE DE LEON. CUARTO PISO
SANTURCE. PUERTO RICO-00909

ADRIAN TORRES
PRESIDENTE

LEO CABRANES
DIRECTOR EJECUTIVO

TELS. 724-1979
725-7838

22 de abril de 1968

Sr. John R. Thoman, Director Regional
Federal Water Pollution Control Administration
Colegio de Abogados de Puerto Rico
Santurce, Puerto Rico

Estimado señor Thoman:

Agradecemos profundamente su invitación para asistir hoy a las vistas que ustedes celebran para discutir la LEY PARA LA RESTAURACION DE AGUAS LIMPIAS DEL AÑO 1966.

Esta ley dispone que el Departamento de Interior de los Estados Unidos lleve a cabo un estudio abarcador sobre los problemas de contaminación en los estuarios de la nación.

La Asociación de Alcaldes de Puerto Rico está sumamente interesada en la solución de este problema en nuestro país y está en la mejor disposición de cooperar en el estudio que ustedes están realizando.

Nos place informarle que la Asociación de Alcaldes de Puerto Rico le someterá oportunamente un memorando contentivo de nuestros puntos de vista sobre este asunto. Nos place además, informarle que ya anteriormente la Asociación de Alcaldes ha expresado sus puntos de vista sobre este problema.

En el día de hoy nuestro buen amigo Hon. Ramón García Santiago, Presidente de la Junta de Planificación de Puerto Rico habrá de representar a nuestro Gobierno en estas vistas y estamos seguros de que él habrá de exponer claramente los puntos de vista de nuestro Gobierno que incluye también, indiscutiblemente los puntos de vista de los Gobiernos Municipales de nuestro país.

En este caso nos honramos conque él nos represente también en esta ocasión ya que sabemos él está profundamente compenetrado de estos problemas y la necesidad de que se solucione a la mayor brevedad posible.

Le deseamos mucho éxito y le pedimos excusas por no haber podido estar presentes hoy con ustedes.

Muy cordialmente,

Leo Cabranes
Director Ejecutivo
Asociación de Alcaldes

NO CEJAREMOS EN NUESTRA LUCHA POR LA AUTONOMIA MUNICIPAL.

Commonwealth of Puerto Rico
Municipal Association
1510 Pounce de Leon Ave., Fourth Floor
Santurce, Puerto Rico 00909

Adrian Torres
President

Tels. 724-1938
725-7835

Leo Cabranes
Executive Director

April 22, 1968

Mr. John R. Thoman, Regional Director
Federal Water Pollution Control Administration
Puerto Rico Bar Association
Santurce, Puerto Rico

Dear Mr. Thoman:

We thank you for the invitation to attend today's conferences which you are giving to discuss the "Clean Water Restoration Act of 1966".

This law provides that the Department of Interior of the United States carry out a preliminary study of the problems of pollution of the nation's estuaries.

The Municipal Association of Puerto Rico is extremely interested in the solution of this problem. It is quite ready to cooperate in the study to be undertaken.

We are pleased to inform you that the Municipal Association of Puerto Rico will submit, at an opportune time, a memorandum containing our views on this subject. We are further pleased to inform you that the Municipal Association has previously expressed itself on this matter.

Today, our good friend, the Honorable Ramon Garcia Santiago, President of the Planning Board of Puerto Rico, is to represent our Government at these conferences. We are sure that he will clearly explain our views.

In this instance, we are honored that he represents us in this, since we know that he is deeply touched by these problems and concerned about the necessity of finding a solution in the shortest possible time.

We hope that you are successful, and we ask your pardon for being unable to attend the meeting.

Very Cordially yours,

Leo Cabranes
Executive Director
Municipal Association

WE SHALL NOT CEASE IN OUR FIGHT FOR MUNICIPAL SELF-GOVERNMENT

THE GEOLOGICAL SOCIETY
OF
PUERTO RICO

Statement at public meeting, April 22, 1968,
on estuarine resources and problems, organized
by the Federal Water Pollution Control Administration

Mr. Chairman, Ladies and Gentlemen:

On behalf of the Geological Society of Puerto Rico I wish to enter the following brief statement into the record of this meeting.

The Geological Society of Puerto Rico is a non-profit scientific and professional organization the membership of which includes most geologists resident and working in Puerto Rico.

An appreciable part of the coastline of Puerto Rico and adjacent inland areas may be included within the estuarine zone, as it is defined in Title II of the Congressional Act authorizing this and similar meetings.

Processes that are characteristic of estuarine zones fall within the purview of a number of scientific disciplines, not the least of which is geology. The principal geologic processes that take place in estuarine zones include erosion, sedimentation, and induration in a variety of chemical and physical forms and in continuous and intricate combination.

At most times such processes proceed in small increments not readily discernible on a day-to-day basis, but occasionally there occur incidents best termed catastrophic that produce striking geologic changes over short periods of time. Such incidents include hurricanes, and their attendant high winds and seas and heavy rains, that can accelerate geologic processes and cause substantial modification of an estuarine environment. A recent catastrophic incident was the short period of extremely heavy seas early last December that resulted in considerable shoreline damage from place to place and in frequent wetting by salt water of areas not normally so exposed.

In sum, geologic processes are among the chief actors where sea and land, thus salt water and fresh water, meet, so estuarine and other coastal zones are legitimate areas of geologic concern. And as Puerto Rico's coastal areas are of great economic, scientific, and cultural value, the Geological Society of Puerto Rico considers that studies in these areas would be incomplete and unsuitable from the point of view of Puerto Rico without due consideration of the geological factors involved.

We urge that your report include a recommendation that geological studies be required features of programs dealing with the resources and problems of estuarine zones.

In urging this, however, we wish to make clear that we are not merely promoting the fortunes of the Geological Society of Puerto Rico and its members. There presently is more work here than can be done by geologists now in Puerto Rico. We recognize that for at least the next decade or more most geology in Puerto Rico will be done by geologists from elsewhere.

In closing, the Geological Society of Puerto Rico wishes to offer the services of its Council and Membership for advice and consultation on geological aspects of estuarine studies in Puerto Rico.

Pedro A. Gelabert
President

The Geological Society of Puerto Rico

CORCO COMMONWEALTH OIL REFINING COMPANY, INC.
BOX 4065 (G.P.O.), SAN JUAN, PUERTO RICO 00936
TELEPHONE: 767-0400 · CABLE: COMOREFCO, SAN JUAN

TEODORO MOSCOSO
Chairman of the Board

April 26, 1968

Mr. John R. Thoman
U. S. Department of the Interior
Regional Director
Southeast Region
Suite 300
1421 Peachtree St., N. E.
Atlanta, Georgia 30309

Dear Mr. Thoman:

Enclosed is a statement prepared for presentation at the public meeting held April 22, 1968 in the Puerto Rico Bar Association theater in Santurce, Puerto Rico, to consider problems affecting the estuarine and coastal waters of the island.

We had hoped that either Mr. Casey, President of our company, or I could deliver the statement in person, but our Annual Stockholders' Meeting was scheduled for the next day, and in preparation for this, Mr. Casey and I and other principal officers of the company were involved in a series of meetings that lasted the entire day and on into the evening.

A member of my staff called your office in Atlanta on Friday, April 19, to explain our situation, and to say that we would do our best to testify. But by early afternoon on Monday, it became apparent that our meetings would last for hours more. We, therefore, sent a representative to your meeting room to inform a member of your committee, and to say we would mail our statement to you.

I have explained this in detail because some local newspapers indicated that Commonwealth Oil, although invited to testify, had disregarded the invitations. By chance, you happened to schedule your meeting on one of the busiest days of the year for our officers. Unfortunately, as a result, we

EXECUTIVE OFFICE BANCO POPULAR CENTER, HATO REY, SAN JUAN, PUERTO RICO
NEW YORK OFFICE, PAN AM BUILDING, 200 PARK AVENUE
PLANTS: PENUELAS AT GUAYANILLA BAY, PUERTO RICO

were unable to be present to reply to a number of erroneous statements made about the petrochemical industry on Puerto Rico's south coast.

We shall appreciate it if you will make the enclosed statement and the accompanying exhibit, entitled "Report On A Special Study of the Bay of Tallaboa", a part of the record of the meeting.

Sincerely,

Teodoro Moscoso

TM:s

Attach

COMMONWEALTH OIL REFINING COMPANY, INC.

Statement Prepared for Public Meeting
Held By U. S. Department of the Interior
Federal Water Pollution Control Administration

April 22, 1968

Puerto Rico Bar
Association Theater
San Juan, P. R.

We are happy to have an opportunity to submit a statement on the use and development of the estuarine and coastal waters of Puerto Rico.

Because of insufficient time, we shall not try to cover all aspects of the subject as outlined in Mr. Thoman's letter of April 1. Instead, our statement is limited to a description of our company's continuing air and water conservation program at our oil refining-petrochemical complex in Peñuelas, on the island's south coast.

Four points should be stressed:

1. The Commonwealth Oil complex is advantageously situated in respect to its ability to reduce air and water conservation problems to a minimum.
2. The company has always been conscious of its responsibilities in this area, and has spent substantial sums of money on anti-pollution programs since completion of its first refinery unit more than 12 years ago.
3. Corco sponsors continuing research programs on air and water conservation and related subjects to determine what improvements may be needed in waste treatment facilities as the company proceeds with its large expansion into petrochemicals.
4. The company will continue to cooperate with all Commonwealth and Federal agencies responsible for studying and trying to resolve problems in air and water pollution, problems that grow in complexity as the nation's population and industries grow in number.

As to the first point -- plant location -- the oil refinery and petrochemical plants now operating in our complex are situated in a fairly isolated area near the shores of the Caribbean Sea, well removed from large population centers. This was an important factor in the selection of the Peñuelas-Guayanilla Bay site for our first plant. Prevailing winds in the area are favorable to the dissipation of waste gases that may enter the atmosphere. Our cooling water effluent, after certain retention time treatment, and the water from our API separators, are discharged into the sea rather than into fresh water streams.

As to point number two -- expenditures on pollution control over a long period of years -- our original system of lagoons and API separators was installed in late 1955. The system was revamped and enlarged in 1957 at a cost of approximately $500,000, and another expansion program was carried out in 1962. Through the years the system developed into approximately 10 acres of lagoons, through which cooling water effluent and ballast water pass in several stages of treatment before going out to sea. To conserve fresh water in the area, our company uses approximately 62,000 gallons of sea water per minute for cooling purposes.

When we started to expand from oil refining into petrochemicals, Corco reviewed the experience of several companies knowledgeable in waste disposal, and selected the Fluor Corporation, of Los Angeles, to study our system and recommend improvements necessary to meet new requirements posed by this major expansion. Their recommendations formed the basis for the $600,000 waste treatment improvement program we are now completing. The program includes a 15,000 barrel tank to handle and treat ballast from ships visiting the Corco docks (this has already been finished); the installation of larger capacity pumps in our lagoons to provide maximum recovery of hydrocarbons as our complex expands; and the installation of secondary oxidation treatment facilities to reduce the chemical oxygen demand and biological oxygen demand. This is the third major expansion of our original waste disposal system in a little more than 10 years. When completed, it will increase our expenditures in waste treatment facilities to several million dollars.

The Fluor study was the first of three studies of the bays adjoining our plants sponsored in whole or in part by Corco over the past three years. A second study, covering water conditions in both Guayanilla and Tallaboa Bays, is being co-sponsored by the company in cooperation with Texaco and Union Carbide. Conducted by experts from the University of Puerto Rico at Mayaguez, this study is under the direction of Dr. Antonio Santiago Vázquez, Director of the Water Resources Research Institute at the Mayaguez school. Because of its scope -- it covers biological, hydraulic and chemical aspects of water and marine life in the bays -- this study is still under way.

Late in 1967, Corco desired specific information on water conditions and marine life in Tallaboa Bay, into which our plant effluent empties. Again the company employed independent outside experts to conduct a survey. The men engaged to perform the assignment were Dr. José A. Ramos, of the Mayaguez College's Department of Biology, and Director of its Graduate School; Dr. Manuel Díaz Piferrer, of the school's Marine Biology Department; and Jaime V. Biaggi, candidate for a Doctorate on Marine Science and Technology at the University of Michigan.

(Their report has been completed, and a copy of it is attached as an exhibit accompanying this statement. It provides a good example of the third point we wish to stress -- our extensive and continuing research in air and water conservation.)

In the opinion of these experts, Tallaboa Bay waters meet standards established by the Department of Health of the Commonwealth of Puerto Rico for estuaries destined for industrial uses. The Tallaboa Bay area is so classified.

The study of the three Mayaguez scientists showed that:

1. Fish production in general in the Tallaboa and Guayanilla Bay areas does not vary substantially from that of other fishing areas in Puerto Rico.
2. Plant life in Tallaboa Bay does not differ substantially from that of similar marine communities in any part of the island. Twenty-four different species of live coral reefs were observed in the area. Because coral is easily killed by the slightest deviation in the typical marine environment, it is an excellent indicator of conditions. In addition, 149 different species of algae were collected in the survey. Plankton and algae were reported present in abundance in both bays.

3. Fish caught in Tallaboa and Guayanilla Bays are mainly the same species as those caught elsewhere in the island. Taste and palatability of the fish caught do not differ from those of fish caught in other areas. Sixty species were collected or observed, but these do not represent all of the species present, only the most common.

4. The pollution control program established by Corco is believed to be completely satisfactory.

The report also made several recommendations that we are now studying. For instance, it recommends the establishment of a biological monitoring program to expand the present monitoring efforts of our Air and Water Conservation Department. A fully-equipped laboratory-boat is suggested for this purpose.

The report also recommends that government, industry and interested groups stimulate and sponsor active local research into the problems of using marine areas of Puerto Rico for industrial purposes.

Our Air and Water Conservation Department, headed by Uriel Ojeda, who holds a chemical engineering degree from the University of Puerto Rico at Mayaguez, already uses a mobile air quality control laboratory, owned by Corco, to provide continuous surveillance of air effluents in our plant area. The mobile laboratory monitors the air in and around the plants and analyzes with exactness what it finds. Other tests are made continually in our plant laboratories, to measure the level of water pollutants and pinpoint their sources.

Such procedures enable us to put corrective measures into effect quickly if they become necessary.

As our president, Sam H. Casey, pointed out in December 1966, at a joint meeting in San Juan of President Johnson's Water Pollution Control Advisory Board and the Water Control Advisory Board of the Commonwealth of Puerto Rico, our company believes that continuing research is the key to a solution of air and water pollution. While we know much about the causes of pollution, we don't know enough.

The efforts of the American Petroleum Institute in this area are especially praiseworthy. Each year, this institute spends millions of dollars on air and water conservation research. We are members of the American Petroleum Institute, we study the results of their research carefully, and adapt whatever may be applicable to the needs of our own plants. For example, we incorporate the latest technological developments, including modern pollution controls, into the design of each new plant. Currently we have four new plants (three of them joint ventures) in advanced stages of design. As another example, we are outfitting a tugboat we have on order with special equipment to handle oil spillages and other emergency situations if they should occur in Guayanilla Bay.

We belong to an industry that is increasingly regarded as the mainstay of Puerto Rico's industrial development program, an industry to which the island is entrusting much of its hopes for a more prosperous economic future. Within the next decade, the petrochemical industry is expected to provide many thousands of urgently needed new jobs and higher standards of living for untold numbers of Puerto Rican families.

We are deeply conscious of the role we have played in helping to pioneer this economic growth, and we are equally conscious of our responsibility to carry out our expansion programs so that they will not have a deleterious effect on other important aspects of Puerto Rican life and resources. Certainly a balance can be achieved between the needs of people for the products of our industry, and the desires of all of us to maintain our invironment in as close to its natural state as possible.

At Corco we recognize the complex problems caused by industrial, agricultural and municipal pollutants. Corco has spent and is spending large sums of money to keep its pollutants under control. We shall continue to be aware of our responsibilities and continue to cooperate in every way possible with your board and the various Commonwealth Government agencies concerned.

Member of the
Chamber of Commerce
of the
United States of America

Cámara de Comercio de Ponce
(PONCE CHAMBER OF COMMERCE)
Apartado 2029 - Teléfono 842-1265
101 Atocha St.
PONCE, PUERTO RICO 00731

Constituted
According to the Law
for the
Formation of Associations

April 10, 1968

TO : Mr. Ramón García Santiago - Representantive
Federal Water Pollution Control Administration
Puerto Rico Bar Association Theater
Santurce, P. R.

FROM : Ponce Chamber of Commerce

SUBJECT : Contamination problems in the estuarine zones in Puerto Rico

It is unquestionable that the establishment of chemical industries and other similar enterprises has contributed considerably to strenghthen and increment the economy of the island of Puerto Rico. However, it is also certain that many of these industries have failed to anticipate the necessary means to deal with the sediments, lees or other chemical elements that seep and ooze into the waters through the different processes involved in their operations.

We know that some steps have been taken to counteract the situation pointed out above, but unfortunately these seem to be only a stop-gap and, therefore, the problems as a whole remain unsolved, constituting a grave danger for the marine wild-life and fish in general.

As it is well known by our local and Federal Governments, there are a series of rivers in this southern area of Puerto Rico, most of them dry for some period of time, but when it rains they carry with them a great amount of noxious matter, either fecal, debris or other decomposed matter, which contaminate the waters. Possibly, reservoirs or dams could be constructed to hold these waters which could be sterilized and then used for irrigation or other purposes, bearing in mind that this southern region is in dire need of water as the drought has for many years now stricken this area, with the resultant death of cattle and other animals, causing too a severe dearth of hay and other feeding products for them.

We understand that there is a procedure used in California that consists of "aerifying" the waters with certain chemical products that kill germs or other noxious agents, so that the waters that flow into the estuaries are free of destructive chemical agents that would affect marine wild-life and fish in general.

We sincerely hope that that Administration will find ways and means to deal with this grave problem, on behalf of the citizens of Puerto Rico, and especially for this southern region that is adversely affected because of the severe drought that has hit it for over ten years.

Manuel Aviles Toro
President

cc-

IN EDUCATIONAL SERVICE TO CITIZENS OF COMMUNITIES, STATES AND THE NATION

THE PUERTO RICO
DISTRICT EXCHANGE CLUBS

Charles H. Reid
Chairman
Clean Up Campaign

P. O. Box 4632
San Juan, P. R. 00905
Tel. 782-0775

22 April 1968

Federal Water Pollution Control Administration
U.S. Dept. of the Interior
Southeast Region
San Juan, P. R.

Gentlemen:

On behalf of the Insular Clean up Committee of the Exchange Clubs of the District of Puerto Rico, I would like to thank you for giving me an opportunity to participate in this public meeting to discuss our National estuarine pollution problems as they are particularly related to the waters of Puerto Rico and politically associated off-shore Islands.

I am confident that ample technical and scientific data will be presented from the group of many capable study panalists and I will, therefore, leave this aspect to these experts.

My brief comments will be related to local problems of water pollution and pollution control as I see them as a member of a Service Club, dedicated to community service and education.

The problem and control of sanitary and storm waste water in Puerto Rico falls under the jurisdiction of many agencies of Commonwealth and Municipal Governments.

Storm sewer disposal is generally handled by the Commonwealth Public Works Department, which is divided into seven Senatorial districts, and seventy six Municipal or City governments.

Sanitary and Industrial Sewer disposal is primarily maintained by the Puerto Rico Acueduct and Sewer Authority, which also provides potable water to most of our Commonwealth communities.

Harbor, Lagoon, Channel and Beach cleaning is done by the Puerto Rico Ports Authority, Ponce Municipal Ports Authority, Commonwealth Parks & Recreation Authority, Commonwealth Public Works Department, bulk handling corporations, Municipal governments and others. More recently the U.S. Navy and other Federal and Commonwealth agencies have joined these groups to assist in the emergency Ocean Eagle disaster in the San Juan harbor.

We feel, therefore, that a Central Commonwealth agency or department should be established for the study, administration and control of water and air pollution in Puerto Rico in an effort to eliminate the cited overlapping and duplication.

Until this new agency can be created, we would further suggest that closer communication between existing agencies and municipalities be developed with the cooperation and assistance of the Commonwealth House of Representatives Committee for Preservation and Beautification of Natural Resources.

Water pollution is a grave concern to all of us and it is gratifying to me to participate in a study of this nature and be aware that this mutual problem is being considered and analized at this level.

IN EDUCATIONAL SERVICE TO CITIZENS OF COMMUNITIES, STATES AND THE NATION

THE PUERTO RICO
DISTRICT EXCHANGE CLUBS

Charles H. Reid
Chairman
Clean Up Campaign

P. O. Box 4632
San Juan, P. R. 00905
Tel. 782-0775

It is my pleasure to pledge the full support of The Puerto Rico District Exchange Clubs to your outstanding efforts.

Thank you for this opportunity to be with you.

Cordially,

Charles H. Reid

Charles H. Reid
Chairman, Exchange Club
Ex-Clean up Campaign
District of Puerto Rico

CHR:ia

cc: Honorable Roberto Sanchez Vilella
Mr. Ramon Garcia Santiago

Testimony to be presented at the public hearing auspiced by the Federal Water Pollution Control Administration on the "Optimum Use and Future Development of Estuarial Resources in Puerto Rico," to be held in San Juan on April 22, 1968.

By Nelson Biaggi, Ph. D.
Professor of Environmental Health
School of Medicine
University of Puerto Rico

Representing:

- **Rectorship, Medical Sciences Campus**
  University of Puerto Rico
- **Dean, School of Medicine**
  University of Puerto Rico
- **Caribe Girl Scout Council**
- **Sociedad Puertorriqueña de Planificación**

1. Many estuaries in Puerto Rico are heavily burdened by pollution either of fecal or industrial origin or both. The cities of Arecibo, Isabela, Aguadilla, Mayaguez, Ponce, Guayama and Arroyo dispose of their raw or untreated sewage directly into the sea. Metropolitan San Juan disposes of some 36 million gallons of primary effluent in the San Juan Bay. The pollutional effect in all cases of this indiscriminate disposal of raw or settled sewage is of a rather critical nature. The San Juan Bay waters, for example, reveal a condition of eutrophication as observed from the photosynthetic activity and the benthal demand excerted by the bottom

sludge (Biaggi and Villares, 1965).(1) The esthetic degradation of these waters goes without saying.

2. It seems urgent for the Aqueduct and Sewerage Authority to:

   (a) expedite toward secondary treatment for all the communities' sewage wastes that so demand.

   (b) examine the financial implications of such enterprise and establish the methodology to effectively comply with it.

   (c) stress optimal managerial operations of the existing sewage treatment plants to assure the best possible results.

   (d) develop master plans for the collection, treatment and disposal of sewage for metropolitan areas thus preventing excessive number of small installations that eventually lead to problems.

3. The great potential value for transportation purposes, esthetical considerations, and others of the San José Lake, the Martín Peña Channel and the San Juan Bay justifies studies in depth on means and ways to recuperate these waters from pollution.

4. Many rivers in Puerto Rico suffer from periodic clogging of their disemboquement thus preventing their discharges into the sea. As a result of this anomalie and due to the pollutional load of the rivers' waters,

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(1) Biaggi, Nelson & Villares E. Study of the Dissolved Oxygen Content of the San Juan Bay Waters. CIAA. Vol. XV, No.4, Oct.-Dec.1965.

anaerobic decomposition does develop with the resulting foulness and anti-esthetic conditions. Also, mosquitoes do multiply in epidemic fashion. The Rio Grande of Arecibo and the Rio Yaguez of Mayaguez are good example of this. The need exist to establish whose responsibility it is to cope with the problem and to see to it that the rivers maintain their flow in continuous discharge to the sea.

5. There are some sugar mills which dispose of their liquid wastes (Biaggi, 1966) (2) in mangrove swamps and these eventually flow into the sea. It must be recognized that the sugar mill wastes exert a very high BOD load and that these mills are among the most important sources of pollution in some of our estuaries. Additional studies on mill wastes are required before any effective abatement program can be implemented.

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(2) Biaggi, Nelson. The Sugar Industry in Puerto Rico and its Relation to the Industrial Waste Problem. Paper presented at the recovened session of the 38th Annual Conference of the Water Pollution Control Federation, San Juan, Puerto Rico. Nov. 1967.

STUDY OF THE DISSOLVED OXYGEN CONTENT OF THE SAN JUAN BAY WATERS

COLEGIO DE INGENIEROS, ARQUITECTOS Y AGRIMENSORES

By Nelson Biaggi and Enrique Villares

INTRODUCTION The dissolved oxygen content of water is essential in biological, chemical, and sanitary investigations as it is one of the most important indicators of the condition of a watercourse. (1) It is necessary for the life of fish and other aquatic organisms and it is essential to prevent septic conditions. Atmospheric or elementary oxygen is soluble to a limited extent in water. In this state it is called dissolved oxygen or, for brevity, the D. O. Unpolluted bodies of water in nature tend to dissolve atmospheric oxygen up to the so called saturation concentration, which is the value of the oxygen concentration in equilibrium with the atmosphere. As the solubility of the gas is proportional to its partial pressure in the atmosphere above, the values which are usually designated saturation value of oxygen in water are only one fifth those which would arise if the water were exposed to pure oxygen at atmospheric pressure. (2)

Biological activity may create condition of oxygen depletion or conversely may cause super-saturation during an algae bloom. Green plants growing in water release oxygen in nearly pure form and under such conditions the solubility of oxygen as heretofore mentioned, would be about five times as great as that under normal atmospheres. Hence, it frequently happens that water supporting heavy growth of plant life are "supersaturated" with oxygen in the sense of the standard table of saturation values. The San Juan Bay waters could well be subject to these extremes due to apparent excessive pollutional loads in one case and to photosynthetic activity in the other.

The solubility of oxygen in water is also a function of water temperature and its salinity which must be distinguished if we are to have a clear perception of the reactions taking place. In any water course carrying organic matters, there are two primary conditions which must be distinguished if we are to have a clear perception of the reactions taking place.

The first may be called the following pollutional load. This comprises all soluble and colloidal material plus any material that is in sufficiently fine state of such division to remain suspended under the conditions of turbulence existing in the body of water. In the presence of excess oxygen this material is oxidized at what is termed the normal biochemical oxygen demand (BOD) rate, and its effect upon the dissolved oxygen of the body of water is reasonably predictable. Another portion of the load is deposited. If the discharge is into sea water, additional precipitation of any soap and fatty acids, not previously combined with calcium salts in the drinking water, takes place. (3) The heavy concentration of dissolved salts in sea water also tends to precipitate colloidal matter which would otherwise remain in suspension. The immediate reactions which take place in the resultant deposits are distinctly different from that found in strictly aerobic or in strictly

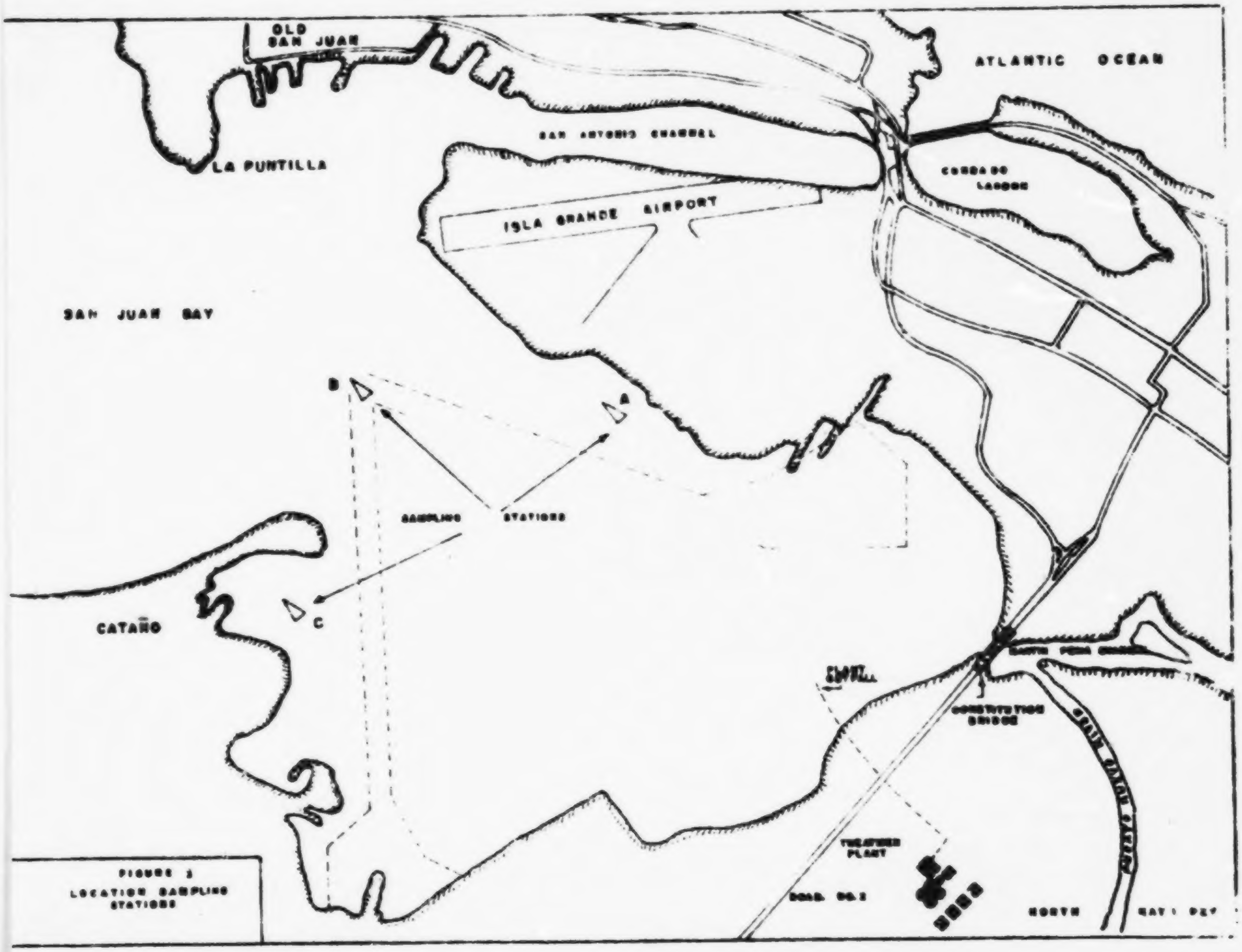


FIGURE 3
LOCATION SAMPLING STATIONS

anaerobic decomposition. In fact it is of the nature of each of these in some respects while possessing certain features found in neither. In the first place it deals with a very slow and long-time reaction. The earliest scientific study of river muds was made by the British scientists of the Royal Commission of Sewage Disposal, (4) who found that the various samples of mud collected from the bottoms of rather highly polluted rivers continued to exert a measurable oxygen demand during incubation in a laboratory for as long a time as 750 days. There was no evidence that the reaction was completed even then. The second characteristic of this type of a water course bottom is that it involves a type of digestion or decomposition, measurable in terms of biochemical oxygen demand, which appears to differ from digestion measured in terms of gas production and practically completed during the course of 20 or 30 days. This much slower reaction takes place under anaerobic conditions but results in progressive decrease in the oxidizability of the residue; its diffusible products are later oxidized in the flowing water above. In view of the unique characteristics of these reactions, Fair (5) has appropriately called them the reactions of benthal decomposition. Thus in the San Juan Bay waters we have to anticipate the utilization of excess dissolved oxygen to supply not only the floating BOD but as well to satisfy the benthal demand exerted by the mud or sludge bed.

OBJECTIVES OF THE STUDY

Two specific objectives are pursued in this study: (1) to ascertain whether or not there exist a significant difference in the D.O. content of the San Juan Bay waters at surface, mid-depth and bottom layers, and (2) to ascertain the D.O. content variations by the hour due to possible photosynthetic reactions.

AQUI: tablas compuestas:I, II, III–

TABLE I.—Average Results of Twelve-Day Analyses by the Hour of the San Juan Bay Waters at Station A, North Side, April 11-12, 1965.

		Temperature, °C			pH			Dissolved Oxygen (mg/L)		
HOUR		Surface (2')	Mid (6')	Bottom (12')	Surface (2')	Mid (6')	Bottom (12')	Surface (2')	Mid (6')	Bottom (12')
	1	27.1	27.0	26.9	8.3	8.4	8.4	4.9	4.9	4.4
	2	27.0	26.9	26.8	8.4	8.4	8.4	5.2	4.5	4.0
	3	27.0	27.0	26.8	8.4	8.4	8.5	5.1	5.0	3.9
	4	27.0	27.0	26.8	8.2	8.4	8.4	5.0	5.2	3.5
	5	26.6	26.6	26.7	8.7	8.4	8.4	5.2	5.3	3.8
AM	6	27.0	26.8	26.8	8.1	8.5	8.4	4.9	4.6	4.5
	7	27.0	27.0	26.9	8.4	8.4	8.4	4.0	4.8	4.0
	8	27.1	27.0	27.0	8.5	8.3	8.3	4.1	4.6	4.0
	9	27.4	27.4	27.4	8.5	8.4	8.1	4.2	5.2	3.7
	10	27.8	27.5	27.3	8.5	8.4	8.7	4.7	4.6	3.7
	11	27.7	27.5	27.3	8.5	8.4	8.1	5.3	4.7	4.2
	12	27.8	27.4	27.4	8.4	8.3	8.4	6.7	4.9	4.5
	13	28.3	27.6	27.3	8.6	8.5	8.4	5.7	4.3	3.6
	14	28.2	27.5	27.1	8.4	8.4	8.4	5.5	4.6	3.5
	15	28.0	27.5	27.3	8.4	8.4	8.4	5.8	4.9	3.7
	16	28.2	27.3	27.3	8.4	8.4	8.4	5.8	5.1	3.9
	17	27.7	27.4	27.3	8.4	8.4	8.4	5.8	5.4	3.7
	18	27.6	27.4	27.1	8.3	8.4	8.5	5.9	5.5	3.9
PM	19	27.9	27.7	27.2	8.4	8.5	8.5	5.5	5.0	3.6
	20	27.8	27.5	27.3	8.3	8.3	8.0	5.5	5.5	4.0
	21	27.9	27.6	27.4	8.3	8.4	8.5	6.0	5.3	3.9
	22	27.7	27.3	27.1	8.4	8.4	8.4	5.9	5.3	4.5
	23	27.8	27.6	27.4	8.4	8.4	8.5	5.8	5.6	4.6
	24	27.6	27.4	27.2	8.4	8.4	8.4	5.9	5.4	4.3
Average Observed D.O., mg/L.								5.35	5.01	3.93
Standard Saturation Value for the D.O., mg/L.*								6.24	6.24	6.24
Per Cent of Saturation Value Observed for the D.O.								85.73%	80.29%	62.98%

* Caculated on the basis of 22,000 mg/L salinity and 28°C.

The findings will permit to establish a more scientifically and practical sampling methodology for future chemical and sanitary investigations of the San Juan Bay waters. It will also allow for a more precise and logical interpretation of the D.O. behavioral pattern in these waters.

METHODOLOGY: Three boats were anchored across the Bay serving as sampling stations and on-the-site laboratories during the twelve-day study. Boat A (at north side of the Bay) was anchored at 16 feet depth; boat B (center-side) at 32 feet depth; and, boat C (south side) at 8 feet depth. These three depths represent the existing depth ranges in the San Juan Bay.

Four six-hour shifts of laboratory workers (students) were established for each boat to perform on site and by the hour the various analyses during the twelve-day study. Fifteen university students were selected and trained to perform analyses for dissolved oxygen, salinity, pH and temperature. The methods of analyses were performed in closed accord to the practices established by the American Public Health Association (1960) (1).

FINDINGS: The average results of the twelve-day analyses by the hour of the San Juan Bay waters at stations A (north-side), B (center) and C (south-side) are presented in Tables I, II and III, respectively. The temperature range observed was from a low 26.6°C to a high 28.9°C, decreasing the temperature in most instances with increases in depth. No significant differences were observed between the three stations. The pH readings at the three stations and for the three depths were more or less the same, averaging 8.40 for station A, 8.35 for station B and 8.30 for station C. The average salinity observed at the three station varied from 22.000 to 23,000 mg/L.

TABLE II.—Average Results of Two-Day Analyses by the Hour of the San Juan Bay Waters at Station B, Center of Bay, April 11-12, 1965

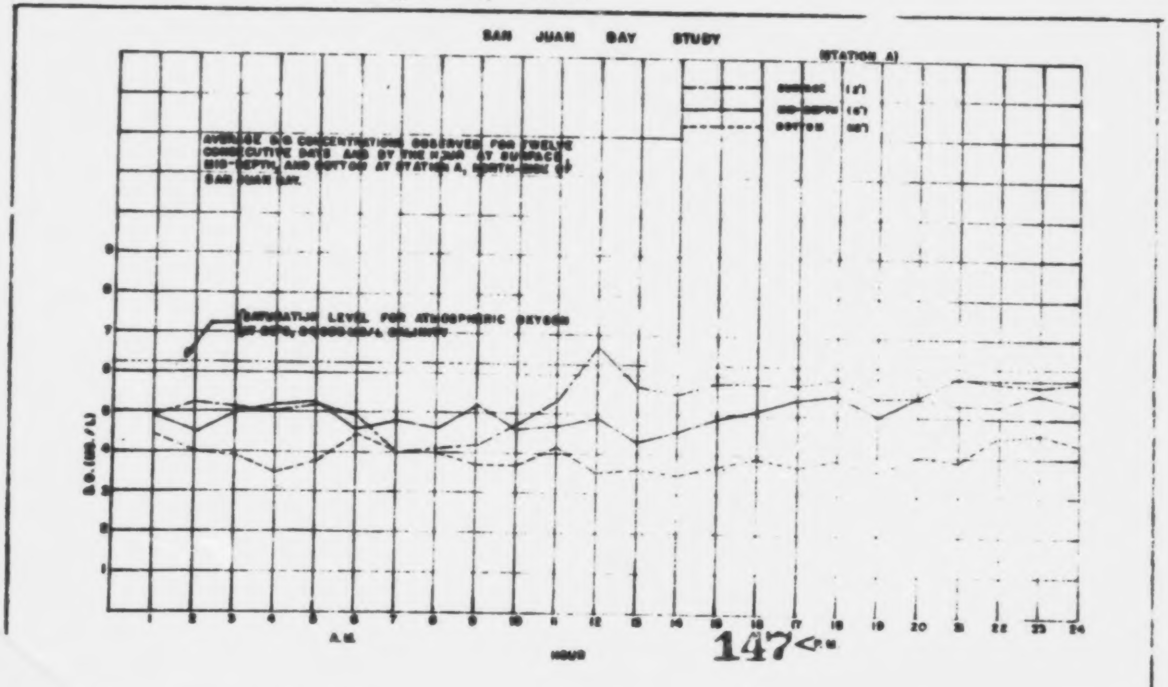
		Temperature, °C			pH			Dissolved Oxygen		
	HOUR	Surface (2')	Mid (16')	Bottom (30')	Surface (2')	Mid (16')	Bottom (30')	Surface (2')	Mid (16')	Bottom (30')
	1	27.1	26.9	26.8	8.4	8.4	8.4	5.7	4.0	3.6
	2	7.1	26.7	26.6	8.4	8.4	8.4	5.6	4.3	4.1
	3	27.1	26.4	26.6	8.5	8.3	8.5	5.7	4.3	4.0
	4	27.1	26.6	26.8	8.2	8.1	8.4	5.4	3.9	3.8
	5	27.2	26.4	26.9	8.4	8.4	8.4	5.4	4.1	4.3
AM	6	27.3	26.5	26.9	8.4	8.4	8.4	5.1	4.6	4.3
	7	27.6	26.8	26.7	8.3	8.3	8.4	5.1	4.5	4.1
	8	28.0	27.0	26.8	8.3	8.4	8.3	5.1	4.7	4.2
	9	27.9	26.9	27.4	8.3	8.1	8.1	5.0	4.1	3.8
	10	28.0	27.0	27.5	8.1	8.3	8.2	5.7	4.6	4.3
	11	28.0	27.3	27.7	8.1	8.1	8.1	5.3	4.2	4.0
	12	28.1	27.1	27.9	8.1	8.1	8.1	5.6	4.1	4.0
	13	27.7	26.7	26.9	8.4	8.4	8.4	5.8	4.5	3.9
	14	27.9	26.6	26.9	8.4	8.4	8.4	6.4	4.3	3.9
	15	27.5	26.9	27.0	8.4	8.4	8.4	5.9	4.5	4.3
	16	27.9	26.6	27.3	8.4	8.4	8.4	6.0	4.4	3.5
	17	27.8	26.7	27.0	8.4	8.4	8.4	6.4	4.2	3.9
	18	27.7	26.6	27.0	8.4	8.4	8.4	6.2	4.5	3.6
PM	19	27.2	26.8	26.8	8.4	8.4	8.4	6.1	4.3	3.6
	20	27.0	26.8	26.8	8.5	8.6	8.4	6.2	4.5	4.3
	21	27.0	26.7	26.7	8.4	8.3	8.5	6.1	4.5	4.0
	22	26.8	26.6	26.7	8.5	8.1	8.0	6.1	4.6	3.9
	23	26.8	26.7	26.7	8.4	8.4	8.5	6.3	4.6	4.1
	24	26.8	26.7	26.7	8.4	8.5	8.5	6.3	4.5	4.4
Average Observed D.O., mg/L.								5.77	4.35	3.99
Standard Saturation Value for the D.O., mg/L.*								6.24	6.24	6.24
Per Cent of Saturation Value Observed for the D.O.								92.47%	69.71%	63.94%

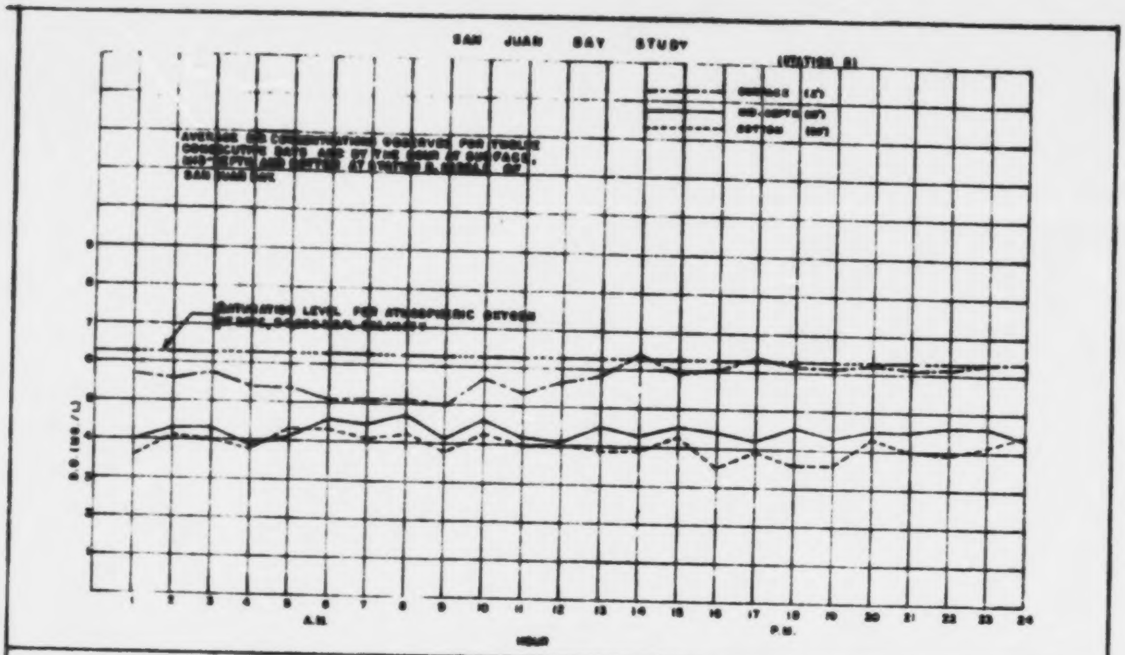
* Caculated on the basis of 22,000 mg/L salinity and 28°C.

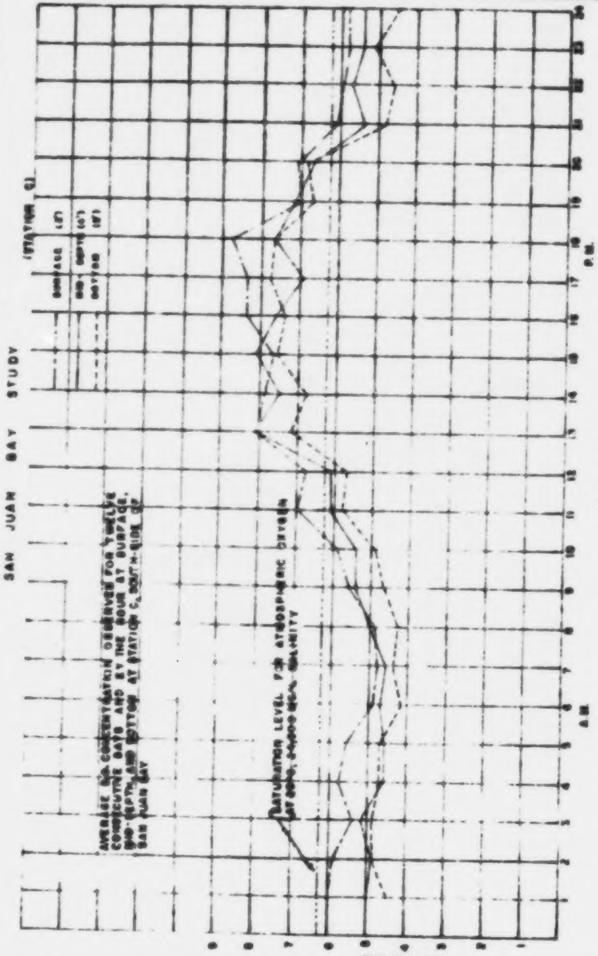
TABLE III.—Average Results of Twelve-Day Analyses by the Hour of the San Juan Bay Waters at Station C, South Side, April 11-12, 1966

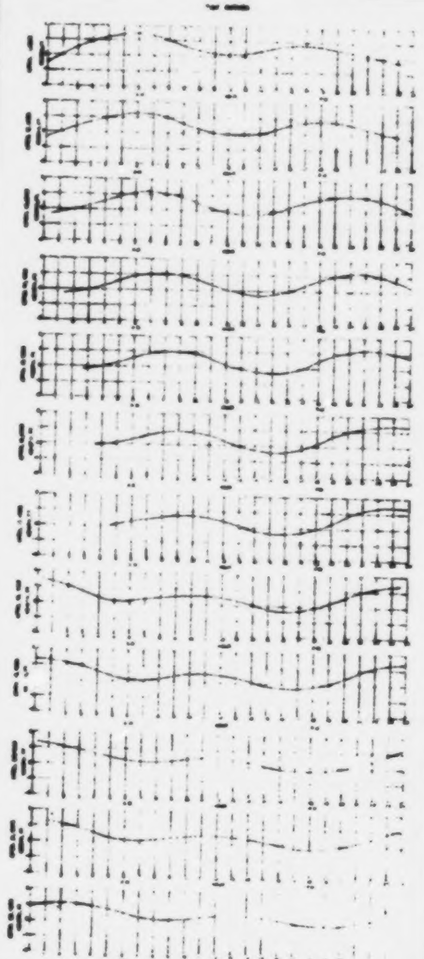
	HOUR	Temperature, ºC			pH	Dissolved Oxygen		
		Surface (2')	Mid (4')	Bottom (6')	Mid-Depth (4')	Surface (2')	Mid (4')	Bottom (6')
	1	28.5	27.0	27.0	8.4	6.0	5.0	4.5
	2	26.9	27.0	27.0	8.4	5.9	4.9	4.9
	3	27.1	27.0	27.0	8.1	5.4	5.2	4.9
	4	27.1	27.0	27.0	8.3	5.8	4.6	4.7
	5	27.0	27.0	27.0	7.9	5.6	4.6	4.7
AM	6	26.9	27.0	27.0	8.4	4.9	4.7	4.2
	7	27.3	27:0	27.0	8.3	4.8	4.6	4.4
	8	27.6	27.0	27.0	8.4	4.9	5.0	4.3
	9	28.1	29.5	27.5	8.4	5.6	5.4	4.7
	10	28.2	27.5	27.3	8.4	5.9	5.4	4.9
	11	28.4	26.0	27.2	8.4	7.0	6.1	5.8
	12	28.7	28.5	28.0	8.3	6.8	6.1	5.7
	13	28.3	28.5	28.0	8.3	8.1	8.1	7.2
	14	28.6	28.5	28.0	8.2	7.9	7.5	6.8
	15	28.8	28.5	28.0	8.3	7.7	8.1	7.6
	16	28.8	28.5	27.9	8.2	8.4	7.6	7.4
	17	28.9	28.5	27.9	8.1	8.4	6.9	7.8
	18	28.8	28.5	27.9	8.3	8.8	7.7	7.7
PM	19	28.1	28.5	28.0	8.4	7.0	7.1	6.7
	20	27.8	28.5	27.8	8.4	7.1	6.7	6.9
	21	28.4	28.5	27.4	8.4	6.1	5.4	4.8
	22	28.2	28.5	27.3	8.5	5.9	5.7	4.6
	23	28.2	28.5	27.1	8.4	5.8	5.4	5.1
	24	28.1	28.5	27.0	8.4	5.9	5.4	4.5
Average Observed D.O., mg/L.						6.49	5.97	5.62
Standard Saturation Value for the D.O., mg/L.*						6.24	6.24	6.24
Per Cent of Saturation Value Observed for the D.O.						104.01%	25.67%	90.06%

* Caculated on the basis of 22,000 mg/L salinity and 28ºC.




SAN JUAN BAY STUDY
(STATION B)
SURFACE
MID-DEPTH
BOTTOM
AVERAGE D.O. CONCENTRATIONS OBSERVED FOR TWELVE CONSECUTIVE DAYS AND BY THE HOUR AT SURFACE, MID-DEPTH, AND BOTTOM AT STATION B, MIDDLE OF SAN JUAN BAY
SATURATION LEVEL FOR ATMOSPHERIC OXYGEN
D.O. (MG/L)
1 2 3 4 5 6 7 8 9
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
A.M.
P.M.
HOUR


SAN JUAN BAY STUDY
(STATION C)
SURFACE (2')
MID-DEPTH (4')
BOTTOM (8')
AVERAGE D.O. CONCENTRATION OBSERVED FOR TWELVE CONSECUTIVE DAYS AND BY THE HOUR AT SURFACE, MID-DEPTH, AND BOTTOM AT STATION C, SOUTH-SIDE OF SAN JUAN BAY
SATURATION LEVEL FOR ATMOSPHERIC OXYGEN AT 29°C, 34,000 MG/L SALINITY
D.O. (MG/L)
A.M.
P.M.
HOUR



The dissolved oxygen concentration observed showed variations by station, by the hour, and with depth. Figures 2, 3 and 4 show these variations graphically. At station A, the average D.O. during the 12-day study was 3.93 mg/L at bottom; 5.01 at mid-depth; and 5.35 at surface. The average saturation value for the station was 76.33 per cent.

At station B, the average D.O. was 3.99 mg/L at bottom; 4.35 at mid-depth; and 5.77 at surface. The average saturation value was 75.37 per cent. At station C, the average D.O. was 5.62 mg/L at bottom; 5.97 at mid-depth; and 6.49 at surface. The average saturation value was 96.58 per cent.

In the three stations, it was observed a more or less marked tendency for increases in the dissolved oxygen toward mid-day and decreases in the night hours. This tendency was most remarkable at Station C, and for the three depths.

The tide curves for the twelve-day study are presented in Figure 5 and these were developed from the tide table predictions of the Coast and Geodetic Survey (6)

DISCUSSION

The observed dissolved oxygen concentrations at the three stations and for the three depths indicate two significant occurrences: one, that the existing benthal decomposition from the bottoms of the San Juan Bay exert a measurable oxygen demand; second, that there is definite photosynthetic activity in these waters. The effect of the photosynthetic activity is observed during daylight hours and at depth where light is still able to penetrate.

The phenomena of photosynthesis occurring in some sections of the San Juan Bay waters is capable of "supersaturating" with oxygen in the sense of the standard table of saturation values. During the hours of darkness, the water is dependent on physical reaeration for its oxygen resources after exhaustion of the "bank of dissolved oxygen" that was elevated to supersaturation levels by acquatic plants.

Obviously, in a conscientious sanitary survey of these waters it is important to sample each station over 24 hours at intervals that are appropriate to reveal information on diurnal D.O. variations. If this is not done and station 1, for example, is sampled consistently around 8:00 A.M. and station 6 around 5:00 P.M. over a weekly or monthly surve, critical D.O. concentrations will not be found. If interval sampling can not be done because of workday restrictions, reversing the time of sampling on alternate days will at least show variations of D.O. that one can expect through an 8-hour workday.

On comparing the D.O. concentrations at surface, mid-depth and bottom layers in the three sampling stations, either individually or as a whole, it is observed that mid-depth sampling results are approximately an average between bottom and surface layers' figures. Thus, when time and money saving be essential in any future sanitary survey of these waters, mid-sampling criteria should be considered acceptable.

In the case of the San Juan Bay, the relatively high per cent of saturation value for the D.O. should not be looked upon as an indication of limited pollution but as the result of released oxygen in nearly pure form by growing green plants. It should be remembered that the solubility of this pure oxygen is about five times as great as that under normal atmospheres.

Surprisingly, there is no marked relation observed between the D.O. concentration behavioral pattern and the tide curves.

CONCLUSIONS

(1) The San Juan Bay waters are favorably affected by the release of almost pure oxygen from growing green plants.

(2) The result of the photosynthetic activity was observed markedly at the south side of the Bay where depth is limited to around 10 feet.

(3) Mid-depth sampling criteria is acceptable for these waters.

(4) There is significant benthal decomposition at the bottom of the Bay and this affects adversely the D.O. concentrations of the water, specially at lower layers.

(5) During sanitary surveys of these waters it is important to sample each station over 24 hours at intervals that are appropriate to reveal information on diurnal D.O. variations. If not possible, reversing the time of sampling on alternate days is recommended.

(6) The relatively high per cent of saturation value for the D.O. in the San Juan Bay waters should not be looked upon as an indication of limited pollution but as the result of released oxygen from photosynthetic activity.

Acknowledgments

Thanks are expressed to the following agencies that graciously cooperated in one way or another with this study: Bureau of Alcoholic Beverages; Finance Department; Antilles Signal Office; Puerto Rico Aqueduct and Sewer Authority; and U. S. Coast Guard. Special recognition is given to the following students who performed the field work: Nelson, Jr, Félix A. Castrodad, Pedro J. Córdova, Marcos H. Dones, Jr., Angel R. Feliberty, William Jiménez, Rafael González Calderín, Roberto González González, José A. Mercado, Enrique Morales, Eladio Pérez Zayas, Juan L. Ricart, Osvaldo Rodríguez, David Saldaña and José A. Serrano.

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UNIVERSITY OF PUERTO RICO
MEDICAL SCIENCES CAMPUS
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THE SUGAR INDUSTRY IN PUERTO RICO AND ITS RELATION TO THE INDUSTRIAL WASTE PROBLEM

By

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THE SUGAR INDUSTRY IN PUERTO RICO AND ITS RELATION TO THE INDUSTRIAL WASTE PROBLEM

Nelson Biaggi

During this recently past 1966-67 milling season, there were 22 sugar factories operating in Puerto Rico as compared to 40 in 1940-41 and to 27 in the 1956-57 season. The sugar factories are fairly well distributed throughout the island with the majority located in the coastal plane near the larger cane producing sections. (Figure 1) The 1967 production was of 818,294 short tons of raw sugar and 52,122,671 gallons of blackstrap molasses (Table 1) as compared to a maximum ever of 1,359,841 and 69,754,084 respectively in the 1950-51 season.

Table 2 shows a steady decline in production of the cane sugar industry in Puerto Rico for the last five years that is creating a hopeless situation. Mills have been closing more or less steadily: Rochelaise and Victoria in 1957; Pasto Viejo, 1958; El Ejemplo, 1961; Constancia-Toa, 1962; Plazuela, Guamaní and Juanita in 1963; Canóvanas, 1965; Santa Juana, 1966; and San Vicente and Cayey in August, 1967. Two more have already indicated intentions to close up. Certain factors have been indicated as the constant menace toward the destruction of the Puerto Rico sugar industry:

- high cost of production
- low sugar yield
- gradual disappearance of the sugar cane planters ("colonos")
- gradual reduction of available land
- labor problems
- financial difficulties

MAP OF PUERTO RICO--SHOWING LOCATION OF SUGAR FACTORIES

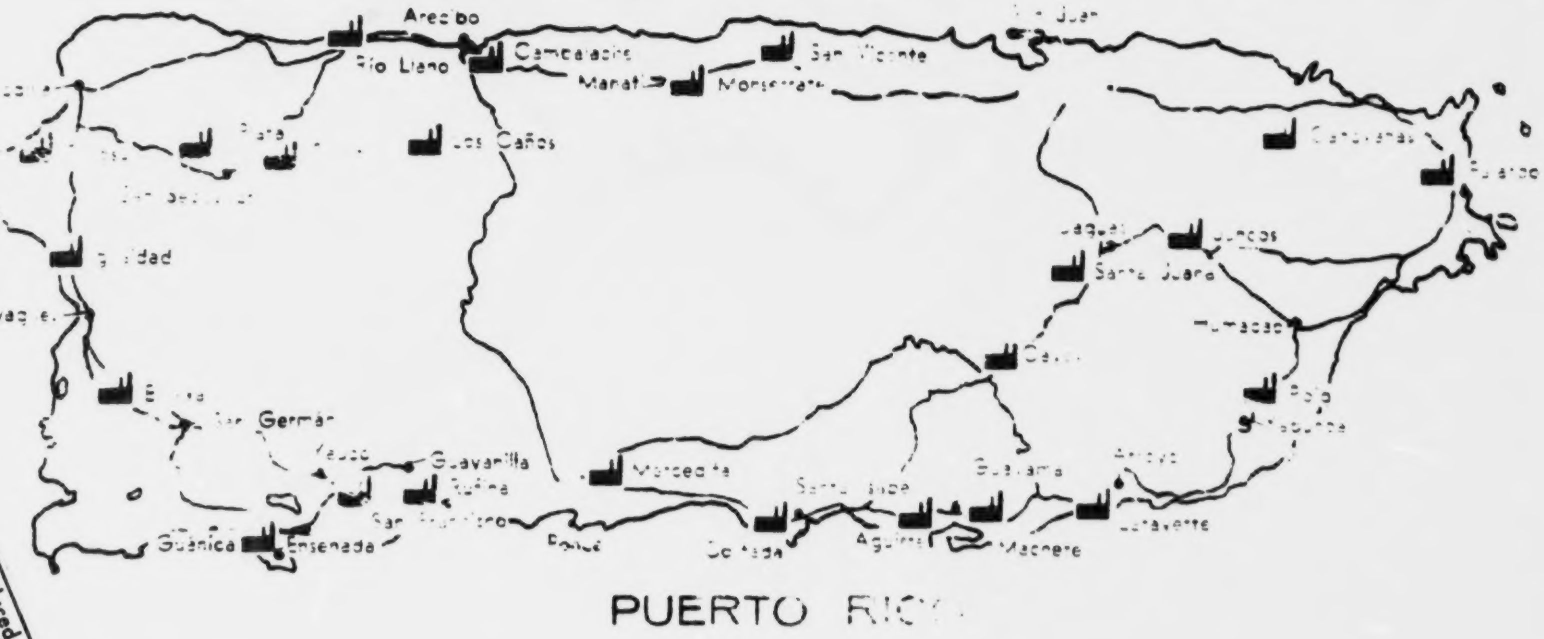
Arecibo
Rio Llano
Cambalache
Manatí
Monserrate
San Vicente
San Juan
Aguadilla
Plata
Los Caños
Igualdad
San Germán
Yauco
Guayanilla
Rufina
San Francisco
Guánica
Ensenada
Ponce
Mercedita
Cortada
Santa Isabel
Aguirre
Guayama
Machete
Arroyo
Lafayette
Roig
Humacao
Cayey
Santa Juana
Juncos
Canóvanas
Fajardo
PUERTO RICO

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Table 1

SUGAR FACTORIES IN PUERTO RICO AND DATA PERTAINING TO THE 1966-67 SEASON

ugar Factories	Tons of Cane Milled	Short Tons of Sugar Produced	Sugar Yield (%)	Molasses (Gallons) Produced	Molasses (Gallons) Storage Capacity
Aguirre	768, 048	84, 553	10.878	5, 499, 199	4, 500, 000
Cambalache	388, 424	35, 820	9.151	2, 187, 831	3, 000, 000
Cayey	123, 920	12, 519	10.001	705, 118	600, 000
Coloso	680, 865	65, 986	9.562	4, 618, 462	1, 300, 000
Cortada	186, 133	18, 553	9.853	1, 221, 354	100, 000
Eureka	290, 246	29, 201	9.948	1, 851, 471	420, 000
Fajardo	468, 998	40, 709	8.618	3, 423, 719	5, 500, 000
Guánica	832, 341	88, 972	10.523	5, 103, 085	3, 060, 000
Igualdad	402, 789	41, 206	10.125	2, 546, 374	850, 000
Juncos	310, 333	30, 128	9.573	2, 072, 989	2, 300, 000
Lafayette	229, 471	23, 114	9.967	1, 454, 361	3, 800, 000
Los Caños	299, 156	26, 470	8.730	1, 697, 534	2, 250, 000
Machete	195, 462	20, 169	10.209	1, 444, 565	100, 000
Mercedita	676, 901	77, 369	11.200	4, 729, 212	1, 800, 000
Monserrate	294, 412	25, 208	8.476	1, 685, 437	2, 500, 000
Plata	600, 798	64, 503	10.613	3, 663, 680	1, 500, 000
Riollano	158, 803	12, 833	7.994	930, 776	50, 000
Roig	473, 178	47, 975	10.013	2, 397, 509	1, 000, 000
Rufina	239, 640	23, 824	9.845	1, 537, 913	3, 700, 000
San Francisco	91, 651	10, 047	10.844	563, 559	77, 000
San Vicente	300, 165	25, 830	8.520	1, 879, 157	3, 000, 000
Soller	148, 461	13, 305	8.870	909, 566	150, 000
Total and Average*	8, 160, 195	818, 294	9.903*	52, 122, 871	41, 557, 000

Table 2

CANE, SUGAR AND MOLASSES PRODUCTION - 1934-1967

Year	Tons Cane Milled	Sugar 96° Produced Tons	96° Sugar % Yield	Final Molasses Produced Gallons
1934-35	6, 760, 385	780, 552	11.546	43, 285, 141
1935-36	7, 592, 205	926, 380	12.202	41, 413, 930
1936-37	8, 144, 289	996, 295	12.233	41, 435, 896
1937-38	8, 800, 292	1, 077, 146	12.240	46, 608, 745
1938-39	6, 874, 943	851, 934	12.392	34, 351, 923
1939-40	8, 795, 932	1, 018, 802	11.583	44, 125, 912
1940-41	7, 745, 419	932, 889	12.044	40, 284, 333
1941-42	10, 010, 131	1, 147, 592	11.464	51, 449, 192
1942-43	8, 678, 014	1, 039, 237	11.976	40, 106, 310
1943-44	5, 602, 167	723, 613	12.917	28, 153, 493
1944-45	7, 998, 384	963, 738	12.049	40, 453, 371
1945-46	7, 538, 589	909, 088	12.059	38, 453, 917
1946-47	9, 286, 263	1, 087, 880	11.715	50, 974, 841
1947-48	9, 541, 232	1, 108, 232	11.615	54, 955, 737
1948-49	10, 998, 035	1, 277, 482	11.616	59, 633, 246
1949-50	10, 614, 633	1, 286, 435	12.119	49, 522, 486
1950-51	10, 501, 394	1, 227, 623	11.690	60, 363, 610
1951-52	12, 536, 940	1, 359, 841	10.847	69, 754, 084
1952-53	10, 170, 796	1, 170, 440	11.508	59, 858, 189
1953-54	10, 879, 643	1, 190, 382	10.941	61, 585, 533
1954-55	9, 872, 969	1, 152, 641	11.675	56, 278, 713
1955-56	10, 306, 433	1, 137, 799	11.040	56, 900, 385
1956-57	8, 710, 684	978, 522	11.234	52, 565, 893
1957-58	9, 007, 336	922, 938	10.179	56, 800, 870
1958-59	10, 181, 755	1, 072, 673	10.535	60, 961, 298
1959-60	10, 000, 728	1, 006, 385	10.063	58, 470, 692
1960-61	10, 754, 017	1, 095, 751	10.189	62, 444, 816
1961-62	9, 663, 265	996, 626	10.314	56, 203, 740
1962-63	10, 122, 518	978, 307	9.665	61, 375, 994
1963-64	9, 802, 224	978, 128	9.979	64, 382, 368
1964-65	8, 806, 972	886, 676	10.068	57, 191, 663
1965-66	9, 465, 009	873, 408	9.228	60, 678, 801
1966-67	8, 160, 195	818, 294	9.903	52, 122, 871

The query with regard to this aging and dying industry is, would it resist a demand from government to provide an adequate treatment for its wastes?

Cane sugar milling is a seasonal operation, depending the length of the season upon the amount of cane available. Under normal conditions, the season starts in January or February and ends in May or June. Since only 4 of the 20 remaining sugar factories have facilities for refining sugar, a great part of the raw sugar is shipped to the States for refining.

DESCRIPTION OF PROCESS

Upon delivery to the factory, the cane stalks are unloaded and conveyed to revolving knives, crushers and from 3 to 5 sets of 3-roll mills. The most common type of installation is one or more 14-roll tandems each consisting of a 2-roll crusher and 4 sets of 3-roll mills preceded by one or more sets of revolving knives. In general practice, water is sprayed upon the crushed cane or bagasse as it emerges from the second and third mills and the thin juice extracted by the last mill is pumped back upon the bagasse as it emerges from the first mill. The process of returning water and thin juice to the bagasse of the first mills is called maceration.

The by-product of cane milling is bagasse, the woody fibre of the cane with the residual juice and moisture derived from the saturation water. This material supplies a very large part and in many instances all the fuel required by the factory. A paper factory in Arecibo uses 80 per cent of the bagasse of an adjacent sugar mill and 5 per cent each of two other sugar factories.

The cane juice from the crushers and rollers is screemed to remove coarse particles, and it is then pumped into weighing tanks. Milk of lime is generally added to the cold juice (to neutralize the acidity thus preventing the inversion of the sucrose molecule to glucose and fructose and to remove impurities) just after it leaves the weighing tanks and prior to entering the heaters where the temperature is raised to near the boiling point. Usually bentonite or some other coagulant aid is added to help in the clarification of the juice. The heated juice is pumped into tanks called defectors or clarifiers where flocculation and sedimentation takes place, causing a thick scum to raise to the surface and the insoluble compounds to settle to the bottom. The clear juice in the center of the tanks is drawn off while the scum and settlings are washed and passed through presses or vacuum filters to remove the last traces of sugar by pumping the juice to the evaporators. The filter cake or "cachaza" from the presses or vacuum filters is piled for later use as a fertilizer in the cane fields or else is mixed with water and disposed by lagooning. An average of about 60 pounds of cake is produced for each ton of cane milled as compared to 25 pounds in past years, the increase being the result of the actual mechanized harvesting that allows mud and other extraneous materials to be brought together with the cane.

The clarified juice is then evaporated in multiple-effect evaporators usually of the quadruple-effect type. The standard quadruple-effect consists of four vertical cylindrical vessels termed bodies, the lower part of each of which is provided with a steam drum fitted with cooper or brass tubes through which the juice is circulated and which are surrounded by steam. The steam drum is termed the calandria. In the center of the calandria is a large tube which carries the juice back to the lower part of the pan as it boils up through the tubes. The space above the calandria, the vapor-space, is connected by means of a large vapor-pipe with the steam-space of the second pan, and the vapor-space of the second and third pans with the calandria of the third and fourth. The vapor-space of the fourth pan is connected by a large pipe with the condenser and vacuum-pump. The juice in the first pan is boiled by the exhaust steam from the various pumps and engines and its water of condensation flows through a trap to the boiler feed water-tank. The vapor generated in the first pan is used to boil the juice in the second; that generated in the second to boil the sirup in the third pan; and that generated in the third to boil the sirup in the fourth pan. The juice is fed into the first pan and circulated from pan to pan and finally reaches the fourth, the thin juice being admitted as fast as the evaporation of the water and the removal of finished sirup permits. A vacuum is produced in the fourth pan by the pump and condenser and in the first, second and third pans by the condensation of the vapors in the calandrias of the second, third and fourth pans.

In some factories the condenser from the evaporators is used in feeding the boilers, in saturating the bagasse, in diluting tank-bottoms (mud) and in washing the various tanks. In some cases the condenser water is wasted and in others it is conveyed to cooling towers where the temperature is lowered and the water reused for condenser purposes.

The sirup obtained in the concentration of the juice in the evaporators still contains from 35 to 40 per cent of water. The water content is further reduced and the crystallization accomplished in single-effect vacuum pans under reduced pressure. The sirup is evaporated until saturated with sugar. At this point crystals or grains separate in the boiling mass. The pan is charged with sirup from time to time, as the water evaporates, and the sugar it contains is largely deposited upon the grain present without the formation of additional crystals. The growth of the crystals is so regulated that they are of sufficient size when the pan has been filled at which point the mixture of crystals and sirup is concentrated to a dense mass, massecuite, and the strike is then discharged from the pan.

The massecuite is conveyed into a mixer and from this is drawn into centrifugal-machines, centrifugals. These machines have cylindrical perforated metal baskets, lined with wire cloth and perforated bronze-sheets and are rotated at high velocity. The sugar crystals are retained by the lining and they are washed with a fine spray of water. The mother liquor, molasses, passes through the lining by reason of the centrifugal force exerted. The machine is stopped after the removal of the molasses and the sugar is cut down, leaving the centrifugal ready for another charge of massecuite. The molasses is returned to the vacuum pan for reboiling with a portion of high-grade sirup to obtain a second crop of crystals, yielding sugar which is about the same quality and an impure, sticky product suitable only for the manufacture of rum, alcohol, and cattle feed.

The raw sugar from the centrifugals is conveyed to hoppers from where it is sacked ready for shipment to the refinery.

A flow sheet of the raw cane sugar industry is attached which shows the various operations and their sequence in the milling process described above. (Figure 2)

SOURCE AND QUANTITY OF WASTE

The wastes from the sugar factories can be roughly divided into four major groups namely: (a) bagasse or the woody fibre of the cane; (b) the filter cake or "cachaza"; (c) cooling and condenser waters; and (d) concentrated wastes from spillage, scum leaks, washings, cleaning, boiler blowdown, and grease and oil from machinery.

Figure 2

FLOW SHEET OF RAW CANE SUGAR INDUSTRY

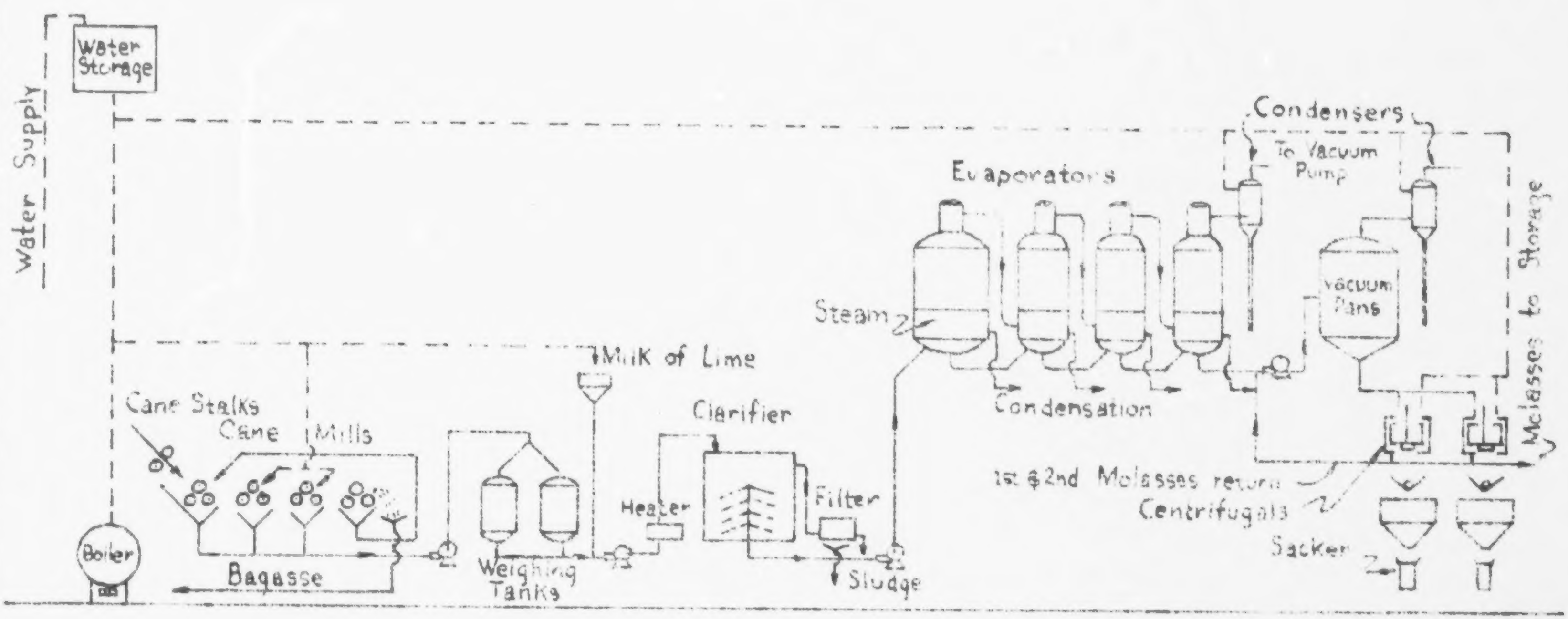
Water Supply
Water Storage
Boiler
Cane Stalks
Cane
Mills
Bagasse
Weighing Tanks
Milk of Lime
Heater
Clarifier
Filter
Sludge
Steam
Evaporators
Condensation
Condensers
To Vacuum Pump
Vacuum Pans
1st & 2nd Molasses return
Centrifugals
Sacker
Molasses to Storage

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Table 3 summarizes the various wastes to be expected from a raw cane sugar factory and shows the approximate quantities of these wastes for which figures are available.

Table 3. Quantities of Wastes from Various Sources in the Raw Sugar Factories

Wastes	Pounds per Ton of Cane	Gallons per Ton of Sugar Produced
Bagasse Fibre	240	
Sludge Cake ("Cachaza")	60	
Cooling Waters and Condenser Waters		30,000
Concentrated Wastes		unknown

BAGASSE

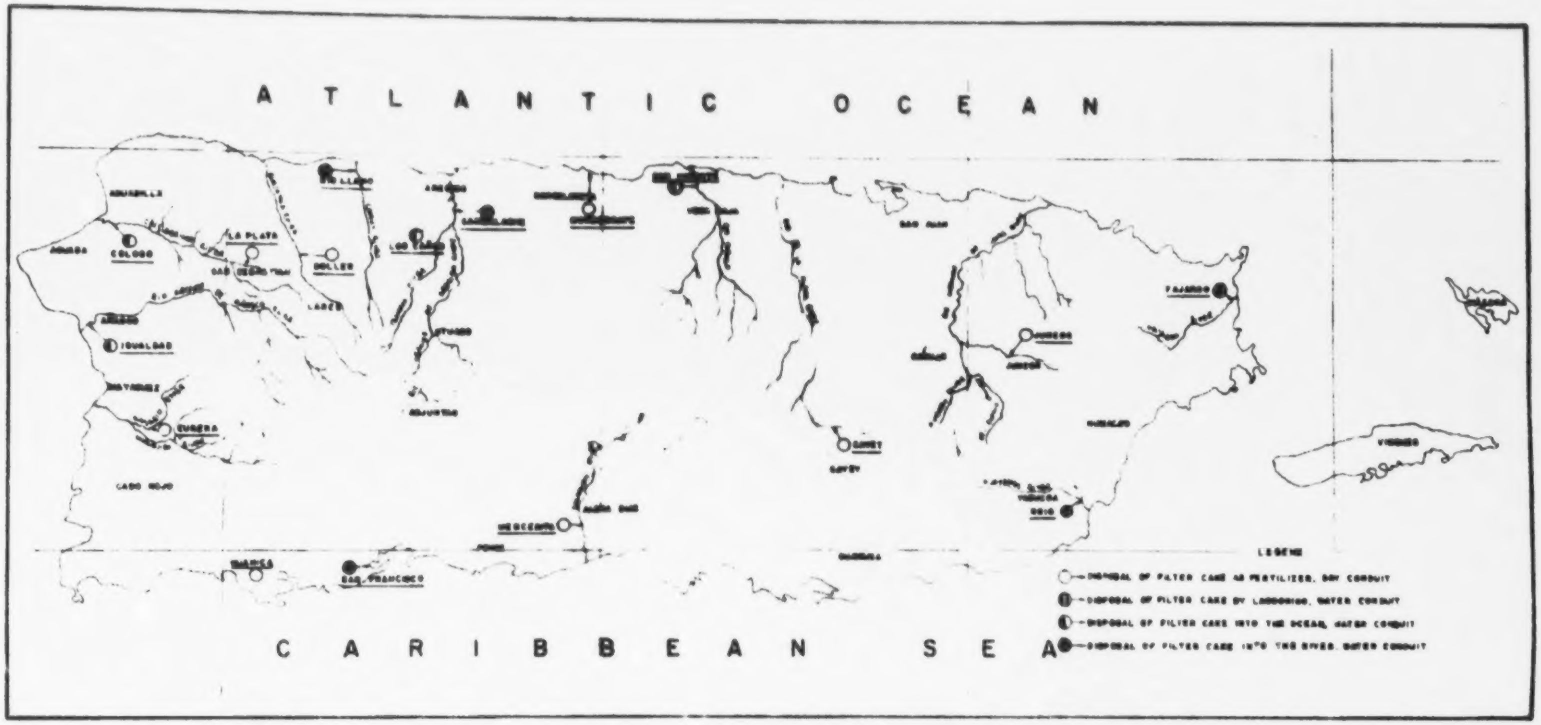
The by-product of cane milling is bagasse, the woody fibre of the cane containing from about 2 to 3 per cent of residual juice and from 45 to 50 per cent moisture derived from the saturation water. The majority of the factories are provided with heating plants that are equipped to burn bagasse, and this material supplies a very large part and in many instances all the fuel required by the factory. As heretofore mentioned, some of the bagasse is being used in the production of paper. Since all of this material is utilized no major disposal problem is encountered. Nevertheless these are aesthetic considerations with regard to their abundance on roads and sorrounding grounds during the milling season.

FILTER CAKE OR CACHAZA

The filter cake is the waste resulting from the clarification of the juice. The proportion of filter cake varies greatly with the method of harvesting, whether mechanized or not, with the locality, efficiency of milling, and juice straining and filter efficiency. The quantity of lime used in the clarification has also an effect on the proportion, i.e., with large volumes of lime more filter cake is produced. The amount of cake per ton of cane gradually increases as the season advances and is at its maximum at the end of the grinding season. An average of almost 60 pounds of cake per ton of cane is produced today as compared to 25 pounds before mechanized harvesting. The juice from the filters is pumped direct to the charge tanks of the evaporators to remove residual sugar.

In the past, most of the filter cake was given away to farmers who spread it in their cane fields as fertilizer or as soil conditioner. This was a most commendable practice both from the sanitary as well as from the agricultural points of views. Apparently, because of economics, some mills discontinued this practice and started disposing of it by lagooning. Thus, the dry conduit and dry disposal system for the filter cake shifted in many cases to a water carriage system leading to the development of foul smelling anaerobic lagoons, and in some cases to its disposal directly into streams or into ocean waters. Figure 3 shows the filter cake disposal

Figure 3


ATLANTIC OCEAN
CARIBBEAN SEA
LA PLATA
COLOSO
LEGEND
DISPOSAL OF FILTER CAKE AS FERTILIZER, DRY CONDUIT
DISPOSAL OF FILTER CAKE BY LAGOONING, WATER CONDUIT
DISPOSAL OF FILTER CAKE INTO THE OCEAN, WATER CONDUIT
DISPOSAL OF FILTER CAKE INTO THE RIVER, WATER CONDUIT

LOCATION OF THE CANE SUGAR MILLS AND DISPOSAL SITE OF WASTES practices used by the 17 mills studied: lagooning, 4; directly to river, 2; to ocean, 3; as fertilizer or soil conditioner, 8. (Figure 3)

The filter cake retains an average of some 0.212 per cent of sucrose. (Table 4) An analysis of this waste as disposed from six selected sugar factories (Table 5) reveals an average BOD of 15,842 mg/L; total solids ranging from 41,420 to 100,333 mg/L with an average of 64,492 mg/L and being around 63 per cent volatile; suspended solids ranged from 16,570 to 70,880 mg/L, with an average of 41,013 mg/L, and also around 63 per cent volatile; and dissolved solids with an average of 32,800 mg/L.

There is sufficient evidence collected during this preliminary study on the high pollution potential of the filter cake to condemn its disposal into any body of water or even by lagooning, the latter because of the foulness produced and the ever present risk for these to drain into rivers or other bodies of water. It seems logical to encourage or even to force by regulatory measures to dispose of this solid and high pollution producing waste by spreading it on the fields as fertilizer or as soil conditioner.

COOLING AND CONDENSER WATERS

The cooling waters are circulated through the condensers and discharged to waste at temperatures ranging from 36° to 51°C with a median of 43°C, depending on the mill. Their dissolved oxygen content is reduced from 6.8 mg/L as an average (ranges from 1.9 to 9.0) to 4.5 mg/L (ranges from 2.2 to 7.8) and therefore their discharge into streams may

Table 4

Sucrose Account of the Sugar Factories Studied

Sugar Factory (Milling Season 1965-66)	SUCROSE ACCOUNT (% CANE)						
	Losses					Sugar	Grand Total
	Bagasse	Molasses	Filter Cake	Udeter-mined	Total		
1. Cambalache	0,750	1,121	-	0.204	2,075	7.199	9,274
2. Cayey	0,972	0,994	0,313	0.085	2,364	8,000	10,364
3. Coloso	1,098	1,001	0,483	-	2.582	8.410	10,992
4. Eureka	1,154	1,231	0,226	-	2,611	9,538	12,149
5. Fajardo	1,141	1,322	0,156	0,164	2,783	8,012	10,795
6. Guánica	1,113	1,098	-	0.439	2.650	9.664	12.314
7. Igualdad	1.031	1.144	0.111	0.137	2.423	8.816	11.239
8. Juncos	1.336	1.440	0.344	0.077	3.197	7.868	11.065
9. La Plata	0.719	1.081	0.110	0.224	2.134	9.242	11.376
10. Los Caños	0.729	0.992	0,268	-	1.989	7.791	9.780
11. Mercedita	0,800	1.337	0.095	0.525	2.757	10.040	12.797
12. Monserrate	0.904	1,124	0.096	0.161	2.285	7.565	9.850
13. Riollano	1.066	1.040	0.362	-	2.468	7.782	10.251
14. Roig	0,662	0,817	0.095	0.089	1.663	9.218	10.881
15. San Francisco	1,755	1.181	0.145	-	3.081	9.610	12.691
16. San Vicente	0.879	1,115	0.448	-	2.442	7.216	9.658
17. Soller	1.065	1,049	0.352	-	2.466	8.186	10.652
Arithmetic Average	1.01	1.122	0.212	0.123	2.468	8.479	10.948
Percentage from Grand Total	9.23	10.25	1.94	1.13	22.55	77.45	100.00

Table 5. Pollutional Characteristics of the Filter Cake, as Observed from Selected Sugar Factories

FACTORIES	Tons of Cane Milled Per Day	Amount Produced Per Day (Tons) (Calculated)	Disposal	FILTER CAKE (CACHAZA)							
				Solids							
				Total			Suspended			Dissolved	BOD (5-Day, 20°C) mg/L
				mg/L	% Volatile	% Fixed	mg/L	% Volatile	% Fixed	mg/L	
Coloso	4,000	126	Lagooning	54,870	58.88	41.12	36,520	56.35	43.65	13,350	16,786
Guanica	7,000	210	Lagooning	100,333	64.28	35.72	38,320	46.97	53.03	65,010	22,440
Riollano	1,800	54	River	47,590	59.15	40.85	16,570	93.48	6.52	31,020	23,500
Roig	4,200	126	Ditch draining to River	74,200	71.68	28.32	70,880	78.44	21.56	33,200	> 8,640
San Francisco	700	21	Ocean and as Fertilizer	41,420	61.15	38.85	18,500	74.70	25.30	22,920	10,650
San Vicente	3,750	112	Lagooning	68,540	61.70	38.30	65,290	27.31	72.69	26,200	> 7,700
Average				64,492	62.81	37.19	41,013	62.86	37.14	32,800	15,842

lower the dissolved oxygen content of the entire body of waters. Where the conservation of water is essential, the cooling waters are circulated through cooling towers or ponds where the temperature is lowered to reuse, yet in most of the sugar factories in Puerto Rico cooling waters are used in a once-through operation.

Apparently, in the evaporation and crystallization processes, sugar particles gain access to the cooling and condenser waters by entrainement in the evaporators and vacuum pans, this being the major source of organic pollution in these waters, as previously reported by Guzmán (1). Losses of sugar by entrainement to the cooling and condenser waters is of economic importance to industry and of great and sanitary significance to the recipient bodies of waters. The high BOD concentration in these waters (Table 6) is a clear evidence that too much sugar is being lost this way.

Table 6 presents the pollutional characteristics of the cooling and condenser waters of the 17 sugar factories studied. It is interesting to observe that over 70 per cent of the solids are in solution and almost half of the total solids are of a volatile nature. The average BOD was 97 mg/L (a median of 84.5 mg/L) with a population equivalent per mill of around 50,000. The total population equivalent of the cooling and

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(1) Guzmán, Ramón. 1962. Control of Cane Sugar Wastes in Puerto Rico. J.W.P.C.F. Vol. 34, No. 12.

Table 6. Pollutional Characteristics of the Cooling and Condenser Waters as Observed from Various Sugar Factories

SUGAR FACTORY	Tons of Cane Per Day (Ave)	COOLING AND CONDENSER WATERS										REMARKS
		Flow Discharge MGD	SOLIDS					BOD, 5 DAY, 20°C				
			Total		Suspended		Dissolved					
			mg/L	% Volatile	mg/L	% Volatile	mg/L	mg/L	Pounds / Day	Pounds / Ton of Cane	Population Equivalent	
1. Cambalache	4,000	17.0	180	44	56	25	150	70	9,900	2.47	58,400	The average BOD of the water used for cooling purposes, before entering the factory, was 8.06 (ranging from 0.9 to > 25 mg/L). Calculations for its population equivalent on the basis of 10.8 MGD (average flow per mill), it came to be around 4,300. This particular BOD load has no relation whatsoever to the milling process.
2. Cayey	1,500	2.0	190	42	13	100	177	72	1,200	0.80	7,100	
3. Coloso	4,000	15.8	250	80	0	0	250	130	17,100	1.28	100,800	
4. Eureka	2,400	7.2	260	38	43	49	190	69	4,100	1.73	24,400	
5. Fajardo	5,400	5.7	310	48	96	46	210	32	1,500	0.28	9,000	
6. Guánica	7,000	31.7	-	-	-	-	-	90	23,800	3.41	140,000	
7. Igualdad	1,800	12.9	200	25	20	0	180	79	8,500	4.72	50,000	
8. Juncos	3,600	Recirculated	690	71	84	94	606	-	-	-	-	
9. La Plata	5,000	12.9	525	51	45	75	480	59	6,400	1.27	37,400	
10. Los Caños	3,400	12.0	190	47	20	0	170	90	9,000	2.65	53,000	
11. Mercedita	6,000	Recirculated	360	42	20	50	340	-	-	-	-	
12. Monserrate	3,000	10.0	280	34	43	0	240	185	15,400	5.14	90,800	
13. Riollano	1,800	7.2	995	38	20	10	980	147	8,800	4.91	52,000	
14. Roig	4,200	12.5	-	-	-	-	-	90	9,400	2.23	55,200	
15. San Francisco	700	4.3	700	29	100	50	600	183	6,600	9.38	38,600	
16. San Vicente	3,750	8.0	-	-	-	-	-	75	5,000	1.33	29,500	
17. Soller	1,450	4.4	770	49	230	78	540	-	-	-	-	
Arithmetic Average	4,214	10.8	421	45	56	41	365	97	9,050	2.97	50,100	
Median	4,000	10.0	335	46	43	50	245	84.5	8,750	2.40	51,000	

condenser waters for the 20 sugar factories existing today is calculated in around 1,000,000. Recirculation of the cooling and condenser waters merits special attention as this practice could well be a possible means to reduce their organic load besides the accompanying reduction in volume discharges, a matter most critical in waste treatment. Recirculation of these waters will also be a solution to the dissolved oxygen depletion of the recipient bodies of water because of the dilutional effect with the once-through operation cooling waters.

CONCENTRATED WASTES The concentrated wastes vary in nature from day to day. They include the plant clean-up water, cleanings of the juice heaters and of the evaporator tubes, washings of the weighing and molasses tanks and molasses and sugar spills. These wastes may be acid or alkaline, depending on the operation used but no attempt is ever made to neutralize them. These wastes must be difficult to treat because of their high carbohydrate concentration, thus leading to an acid environment upon biological decomposition.

The floors of the plant are usually washed down weekly and the washings usually contain some bagasse fibre, sugar, molasses and miscellaneous wastes.

The juice heaters usually foul very quickly. The typical method of cleaning is to circulate hot caustic-soda solution through the tubes and follow this first with water and then with hot dilute muriatic acid. The soda solution is usually returned to a storage tank for repeated use, decanting it from the mud and adding soda from time to time to maintain a strength of about 1 pound of soda to 7 gallons of solution. Occasionally the scale in the tubes is of a very resistant nature and must then be removed by scraping the surfaces. The spent caustic soda is discharged to waste periodically.

As a result of the concentration of cane juice, various substances which have been dissolved in the thin juice are separated in an insoluble state, they partly remain in the juice, rendering it turbid, and are partly deposited as a hard crust on the tubes, chiefly on those of the last vessel, and interfere with the conduction of heat, and hence, with the evaporation.

The evaporator tubes are cleaned by means of a caustic soda solution. The pans are filled to above the level of the tubes with a caustic soda solution containing from 1 to 2 pounds of the soda per cubic foot of solution. This soda solution is boiled during several hours and is then run from the pans into an iron or lead-lined storage tank. The soda solution is reused and the sludge discarded. The pans are then washed with water and then boiled with dilute muriatic acid which is afterwards run into the sewer. This treatment is repeated at about weekly intervals to keep the heating surface in good condition. At the end of the manufacturing season, it is usually necessary to give the tubes a thorough scraping. The alkali solution is usually used repeatedly, by adding caustic soda from time to time as it becomes weakened. The soda solution is always boiled under atmospheric pressures in cleaning evaporators and pans.

The mills are washed with hot water at weekly intervals and the waste water discarded. The weighing and molasses tanks are washed with hot water three times daily and the centrifugals are washed after each strike, the water being returned to remove the residual sugar.

The majority of the sugar factories today have sufficient available storage space to hold the volume of molasses produced each season. (Table 1) In the past, occasional spilling of this material into the streams has been responsible for the depletion of the dissolved oxygen content and the destruction of all fish and plant life for a considerable distance below the outlet. The BOD of raw molasses (82.6° Brix) is possibly among the highest BOD figures ever reported for a particular liquid waste, 426,000 mg/L. (1)

Under normal conditions, the excess of molasses over storage space represents no serious problem when the excess can be sold locally or shipped to the States. Nevertheless, it is pertinent to keep an eye on excess carried over from previous year as molasses spill could become more frequent.

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(1) Biaggi, Nelson - 1956, Studies on Rum Distillery Wastes in Puerto Rico, page 45, University of Michigan.

SUMMARY AND CONCLUSIONS

The sugar industry in Puerto Rico seems to be dying out at a relative high pace due to various factors, some of which are probably beyond control. The question arises whether it could resist a demand from government to provide an adequate treatment for its wastes or whether it will be wiser and possible for industry to increase its industrial efficiency and management with a system or policy conducive to waste controls and reduction. A description is made of the milling process from the delivery of the cane stalks to the mill through the formation of the sugar crystals and the production of the various wastes and of the by-product molasses. The quantities of wastes from the various sources are presented either as pounds per ton of cane or as gallons per ton of sugar produced.

The wastes are roughly devided into four categories, namely: (a) bagasse or the woody fibre of the cane; (b) the filter cake or "cachaza"; (c) cooling and condenser waters; and (d) concentrated wastes from spillage, scum leaks, washings and others. A brief description is made of each one and of their disposal practices. The pollutional characteristics of the filter cake and of the cooling and condenser waters from various sugar factories are analyzed and presented including data on total, suspended and dissolved solids, and their respective percentages of volatiles; and, BODs. There seems to be sufficient evidence collected on the high pollution potential of the filter cake to condemn its disposal into any body of water or even to its disposal by lagooning. The most convenient way to dispose of the filter cake is by spreading it on the field as fertilizer or as soil conditioner. Regulations to this effect seems to be mandatory.

The cooling and condenser waters of the 20 sugar factories have a total BOD population equivalent of around 1,000,000. The high BOD concentration in these waters (97 mg/L) is a clear evidence that too much sugar is being lost into them by entrainement. Efforts should be made by industry to cut on these sugar losses that are responsible for the high organic load of the cooling and condenser waters, besides the economic implications of these losses. Recirculation of the cooling and condenser waters merits special attention as this practice could well be a means to reduce their organic load besides the reduction in volume discharges, the latter a matter most critical when considering waste treatment.

The concentrated wastes vary in nature from day to day. They may be acid or alkaline yet no attempt is ever made to neutralize them. Their volume is relatively small but their BOD concentration could be very high. Molasses, for example, has among the highest BOD ever reported, 426,000 mg/L.

Inasmuch as the sugar factories do not have sufficient cane to mill or to process economically, being this one of the important reasons why so many factories have been closing down, it seems advisable for governme and industry to jointly plan on the optimal number of factories that should remain open. Efforts should be made by government on tax write-off, guarantees for low interest loans for purchase and installation of equipment that will permit minimal sugar losses, and other similar incentives conducive to waste controls and reduction rather than waste treatment at the end of the line. Government incentives should have effect on emphasizing industrial efficiency and better management rather than waste treatment.

Acknowledgement

This preliminary study has been a cooperative effort between the School of Medicine and the Department of Health of Puerto Rico. Thanks are expressed to the Junta Azucarera de Puerto Rico, to the Asociación de Productores de Azúcar de Puerto Rico and to the seventeen factories studied that graciously cooperated with the study team. Special recognition is given to Mr. Enrique Villares and Mr. José Villafañe without whose help this report would not have been possible.

UNIVERSITY OF PUERTO RICO AT MAYAGUEZ
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DEPARTMENT OF GEOLOGY

April 8, 1968

Director
Technical Programs
Southeast Water Laboratory
Federal Water Pollution Control Administration
Athens, Georgia 30601

Dear Sir:

Dr. John D. Weaver, Director of the Department of Geology of this university, named me to represent him at the Public Meeting National Estuarine Pollution Study to be held in San Juan, Puerto Rico, on April, 22.

I am pleased to include with this letter a statement for the meeting.

Sincerely yours,

George A. Seiglie
Assistant Professor

Enclosure

Exposición para la Reunión Pública sobre el Estudio Nacional de Contaminación en Estuarios, Abril 22 de 1968

(Statement for Public Meeting National Estuarine Pollution Study, April 22, 1968.)

Pueden hacerse muchos enfoques desde el punto de vista geológico en lo que se refiere al estudio de los estuarios y sus zonas de influencia. Cada uno de estos enfoques abarca en sí una especialidad diferente de la geología. Tres aspectos son especialmente interesantes aquí: 1) estudio de la distribución y movimiento de los sedimentos, 2) estudio geoquímico de los sedimentos y 3) estudio de la distribución de los foraminíferos.

Los foraminíferos son protozoarios provistos de una concha calcárea o arenácea. Su tamaño pequeño, su abundancia en las aguas saladas y salobres y el hecho de que su concha puede conservarse indefinidamente después de muerto el animal ha hecho a los foraminíferos herramientas utilísimas a la geología. Estas mismas razones han incrementado en magnitud extraordinaria las aplicaciones de los foraminíferos a la oceanografía.

Desde comienzos de esta década ciertos indicios permitían suponer que en el sur de California debía existir una relación entre la distribución de los foraminíferos y la contaminación de las aguas. O. Bandy, J. Ingle y J. Ressig estudiaron la distribución de los foraminíferos en relación con los desagües de albañal de varias ciudades. Se encontró que varios parámetros de la distribución de los foraminíferos tenían una disposición característica en relación con los desagües. Estos estudios fueron realizados gracias al aporte económico de U. S. Public Health Service.

También bajo los auspicios de esta institución se están realizando en el estuario del río Hudson en Nueva York estudios sobre los sedimentos y los foraminíferos.

Recientemente por un programa que se realiza por la división de Biología Marina del Centro Nuclear de Puerto Rico se encontró que en las bahías de Mayagüez y Añasco existían algunas asociaciones poco comunes de foraminíferos que parecían guardar relación con la contaminación de las aguas en estas áreas. La falta de equipo y personal no han permitido llegar muy lejos en estas observaciones. El Departamento de Geología de la Universidad de Puerto Rico está en disposición de realizar estudios sistemáticos de las bahías y aguas costeras de Puerto Rico siempre que pueda contar con equipo apropiado.

Recientemente ha presentado un proyecto a la Federal Water Pollution Control Administration para el estudio de la distribución de los foraminíferos y los sedimentos en las Bahías de Mayagüez y Guayanilla en la finalidad de poder emplear los foraminíferos como indicadores de contaminación.

Se ha comenzado un estudio preliminar de la fauna de foraminíferos en la Bahía de Guayanilla como tesis de grado de un estudiante graduado. A través de un programa de estudios graduados pueden realizarse trabajos con el fin de determinar las faunas de foraminíferos en las aguas costeras de Puerto Rico que tengan la posibilidad de estar contaminadas. La acumulación de estos datos traería un aporte contínuo de información con la cual podrían establecerse conclusiones de gran utilidad práctica sobre las relaciones entre los foraminíferos y la contaminación de las aguas.

STATEMENT FOR THE PUBLIC MEETING CONCERNING THE NATIONAL STUDY OF ESTUARINE POLLUTION, APRIL 22, 1968

From the geological point of view, many points can be focused upon in reference to the study of estuaries and their zones of influence. Each focal point, in itself, opens and includes a different field of geology. Here, three aspects are especially interesting: 1) a study of the distribution and movement of sediment, 2) a geochemical study of sediment, and 3) a study of the distribution of foraminifera.

Foraminifera are protozoans provided with a calcareous or arenaceous shell. It's small size, it's abundance in salt and brackish waters and the fact that the shell can be preserved indefinitely after the animal's death, have made the foraminifera very useful tools for geology. These same reasons have increased the applications of the foraminifera to oceanography in an extraordinary magnitude.

From the beginning of the present decade, certain signs permit the supposition that a relationship should exist between the distribution of foraminifera and water pollution in Southern California. O. Bandy, J. Ingle, and J. Ressig studied the distribution of foraminifera in relation to the sewage disposal of various cities. It was found that the various parameters of the foraminiferal distribution had a characteristic placement related to the sewage drainages. These studies were realized thanks to the financial aid of the U. S. Public Health Service.

Under the auspices of that institution, studies on sediments and foraminifera are being carried out in the estuary of the Hudson River in New York.

Recently, through a program being carried on by the division of Marine Biology of the Puerto Rican Nuclear Center, it was found that some associations uncommon to foraminifera, which appeared to preserve a relationship to water pollution, existed in the Bays of Mayaguez and Añasco. Lack of equipment and personnel has not permitted those observations to go very far. The Department of Geology of the University of Puerto Rico is in a position to carry systematic studies of the Puerto Rican bays and coastal waters so long as it has the appropriate equipment.

Recently, the Department of Geology has presented to the Federal Water Pollution Control Administration, a project for the study of the distribution of foraminifera and sediments in Mayaguez and Guayanilla Bays in order to be able to use the foraminifera as indicators of pollution.

A perliminary study of the fauna of foraminifera in Guayanilla Bay has been undertaken as the graduating thesis of a graduate student. Through a program of graduate studies, work can be conducted with the purpose of determining the fauna of foraminifera in the coastal waters which may possibly be contaminated. The accumulation of those data should bring a continuing flow of information. With this information, conclusions of great practicle utility might be established concerning the relationships between the foraminifera and water pollution.

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END